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Mr. Beauchamp's Benevolent Appeal.

FEW things can be more appropriate than that the first public service rendered by Mr. J. W. Beauchamp after relinquishing his position at the head of E.D.A. should be an appeal for funds.

After eight years begging for, and building up, funds to be expended by the industry upon its own development, he must be excellently qualified for voicing that appeal that comes to the heart of the whole industry once a year for a big Festival addition to be made to the fund for assisting those who fall by the way as that industry develops—we refer to the Electrical Trades Benevolent Institution.

Mr. Beauchamp is the president for the fifteenth annual festival which takes place at the Trocadero Restaurant on Wednesday, February 8th. We hope that there will be a record number of tickets sold for that dinner, and that all the collecting lists will show a good return of donations, but our special desire at this moment—and be it noted that time is getting on—is that the personal appeal of President Beauchamp shall meet with a generous response. Large numbers of men have been closely brought into touch with him during the past few years, and there are many of them—electricity suppliers, manufacturers, wholesalers, and contractors—who might well embrace this as an occasion for recording their personal appreciation of all that Mr. Beauchamp has done, by sending in a bumper donation to the Fund for which he pleads in his official appeal.

Though this is only the fifteenth annual festival, the Institution held its first dinner nineteen years ago, the origin being a surplus of funds remaining from an Olympia Electrical Exhibition. At that first dinner, held at the Hotel Metropole, as both Sir William Preece and Prof. Perry were absent through illness, Mr. W. M. Mordey stepped into the gap, and was supported by the late Mr. R. Kaye Gray, while prominent as usual among the artistes at benevolent and other functions of the times, was the late Mr. T. E. Gatehouse, of the ELECTRICAL REVIEW, with his violin. It was pointed out in one of the speeches on that first occasion that pensions

could not be granted until the Institution had been at work for some years and had accumulated sufficient funds for the purpose, and the appeal, then begun, for pension funds has not yet ceased—nor can it do. We have a long way to go before the electrical trade can catch up to the very fine achievements of our other great trades, and we trust that measures may be found available before long which will accelerate the rate of progress in that direction.

Since the movement began, efforts of all kinds have been put forth to interest all classes connected with the industry—employers and employed—and increase the resources. The achievements of successive presidents and of the staff and committees of the Institution have been substantial, but not nearly so large as they should have been considering the growth of the industry. At the present moment there is approximately £34,000 cash in hand and invested, while the outpayments by way of grants or pensions during the past year have been over £2,000, as compared with about £1,000 in the previous year. This growth in grants is gratifying, but more and more must be done.

We have lent our columns, and any power of appeal that we might possess, to this Institution right from its birth; we have been in the midst of every effort to increase its influence for the benefit of those in the industry; and we are giving the subject full prominence again to-day, because we want the organisation to become a far greater thing than it is. It will not become so by querulous, ignorant fault-finding, but by thoughtful, constructive and aggressive work accompanied by earnest and wide-spreading appeals in which the truth is told concerning the good that has been and remains to be done.

We pass on to every reader Mr. Beauchamp's appeal on behalf of those who by reason of impoverished health, or some other unfortunate circumstances, are suffering hard times in silence, and are by reason of their position beyond the reach of other charitable or provident associations.

Are we too busy with our active electrical and social interests to regard the often mute appeal of unemployment and disappointment, suffering and hunger, pain and loss?

The Institution could do far greater good if the whole electrical industry would resolve here and now to make one grand united response. We appeal both for substantial sums, and for small donations, to be sent in large numbers and without delay, addressed to Mr. J. W. Beauchamp, Festival President, E.T.B.I., 36 and 38, Kingsway, London, W.C.2.

The Indian Electrical Market.

FOR some time past there have been indications that the British position in the Indian market is not so impregnable as has been supposed. Our manufacturers cannot now rely solely upon the British origin of their goods to sell them in India, and much more has to be done than in the past to make sales certain. The competition which has arisen comes not only from the Continent and the United States—home industries are developing under the encouragement of the Government and with the approval of many important purchasers.

The report by Mr. T. M. Ainscough, Senior Trade Commissioner in India, which is reviewed elsewhere in this issue, states that the Department of Posts and Telegraphs, a large buyer, has obtained Indian-made h.d. copper wire, glass battery jars, and insulators, although it is noted that the local supply of the last falls far short of the demand.

This form of competition may not be very serious, but the increasing tendency to buy goods in the Indian market instead of leaving it to outside purchasers, is something which must be reckoned with. While, for instance, the Indian Stores Department confined its business to London, British manufacturers held a very considerable advantage. Now that the Department is purchasing in India, British and foreign firms compete on equal terms.

Continental electrical accessories have gained a footing on account of their low prices. Although their finish leaves something to be desired, they are said to be good enough for the market and appear to serve their purpose. Mr. Ainscough suggests that British manufacturers should take a leaf out of their competitors' book by making this class of fitting, under a separate name or trade mark.

Other means of meeting the competition are put forward, the principal suggestion being a thorough reorganisation of trading methods. It is considered that the export merchant, who has been invaluable in the past, is now an inadequate vehicle of trade. Mr. Ainscough says:—"The time appears to have come . . . when, in order adequately to work the Indian market, the home shipper will be obliged to open offices in India and establish a sales organisation on the spot."

We are sure that most of the electrical manufacturers are alive to these changing conditions, but there may be some to whom the report will come as a warning.

Overhead Lines.

BY placing before the Overhead Lines Association last week a full account of the conditions under which electricity supply has been developed in France, and the methods of control and construction which have been evolved, Major T. Rich did good service to the members. The large amount of water-power available, and the restricted area within which the coal deposits are found, render the problem very different from that which is faced by our Central Electricity Board; whilst it is generally much cheaper here to carry coal to the place where power is required than to transmit electricity over the same distance, water-power offers no such alternative—long-distance transmission of electricity is essential to its utilisation. This fundamental contrast between the conditions obtaining in this country and those which reign in France, Germany, Italy, and other Continental countries, which was obscured for political ends during the discussion on the Electricity (Supply) Bill of 1926, ought to be constantly kept in mind when the broad question is under consideration.

But the distribution problem is more or less common to all nations, and by studying the methods which have been found satisfactory abroad we may learn much that is applicable to our own needs. Now is the time to do this, when—with due respect to the admirable efforts of our persevering pioneers—the field of rural distribution is practically virgin soil, and we have the opportunity of adopting the best and cheapest practice almost from the start. If this is not done, we shall pay heavily not only for work that is carried out on extravagantly costly lines, but also for the delay in development that will inevitably result from starting on wrong lines and shouldering a burden of wasted capital.

As Major Rich convincingly demonstrated, rural electrification has already been so far developed in France that her engineers have gained a vast fund of practical experience upon which we can draw, at negligible cost to either party, but with immense profit to ourselves. This is true not only in respect of actual construction, but also with regard to the national organisation. There, electric power is not looked upon as a pert stripling who has to make way for his betters and put up with a chilly welcome, but as a full-grown and essential factor of prosperity, of even greater importance than some of his elder brothers. That is the spirit that must be cultivated in this country, amongst all classes of the community; and then "the best possible facilities" foreshadowed by the Electricity Commissioners in their last Report will be well on the way to realisation.

Shoddy Wiring.

The author refers to the harm done to the electrical industry by bad installation work, discusses how the jerry wireman and shoddy work may be suppressed, and scathingly exposes the weaknesses of the National Register of Electrical Installation Contractors.

By H. R. TAUNTON.

"THE conflagration is believed to have been occasioned by the fusing of an electric wire." So runs the journalistic *cliché*, the stereotyped tail-piece to the Press report of any fire. Usually it is a gross libel on the electrical contractor concerned, a libel which is rarely corrected; for by the time the true cause is discovered, the fire itself is stale news on which the newspaper is unlikely to waste the space necessary to vindicate the fair name of electricity. So the *cliché* is left standing in type, ready for the next fire sensation; and the reporter finds his justification—if his conscience pricks him at all, which is very doubtful—in the knowledge that if he "says it three times it will be true." Or if not the third time, perhaps the fourth, or the fifth. For this he has the support of the fire insurance companies. In an interview recently appearing in the papers, an official of one of them attributed most of the fires of recent years to three main causes: central heating, modern well-grates, and electric lighting.

"There you are!" says the reporter. "Conflagrations *are* occasioned by the fusing of an electric wire! So is it likely I'm going to talk about old stuff like grates and boilers?"

He is right, unfortunately. He says, to translate his journalese into ordinary English, that some fires are caused by electrical defects—and we cannot gainsay him. It may seem almost incredible to us, who know the wide margin of safety afforded by an electrical installation carried out with reasonable care and decent materials. From such an installation only the incalculable freaks of fate or folly could strike a fatal spark, and were there no others, we should hear no more of electrical fires and lethal shocks—accidents and fools apart.

But, alas, there *are* others. There are not only the wiring jobs to which fires have been justly attributed; there are, as every contractor knows, as almost every issue of the technical Press testifies, countless others which only an undeserved miracle has saved from figuring in an inquest report. The jerry wireman is always with us, blazing an inflammable trail of death traps, ignorant, irresponsible, unchecked, encouraged indeed by the layman's clamour for cheapness.

Shoddy wiring! The curse of the contracting trade; admitted, deplored by all of us; combated by—whom?

What are we doing, or even "going to do," to restrain the fatal activities of the cheap-jack? No easy problem, admittedly. But are we ever going to take a first step towards its solution; ever going to do any more than discuss it helplessly, as we have done for the last twenty or thirty years? Every year, with the increasing use of electricity and the lowering of the standards of commercial integrity—if we are to believe *laudatores temporis acti*—the problem becomes more acute. Not much longer can it be shelved, as of old, with a shrug. Not much longer can our reputation as a class carry the sins of the swindling bunglers who are allowed to call themselves, even as we do, electrical contractors.

If we do not quickly tackle the job ourselves, and drive from our house those who now dishonour it, we shall shortly find it done for us, over our heads—and our house probably made very uncomfortable for us. Sooner or later, the Government will find time from the discussion of the sale of chocolates to consider the minor question of fire and sudden death to which the lieges are exposed by the non-existence of any authoritative standard of electrical installation work. And lo! we shall have a thousand new rules and ten thousand new inspectors; we shall be cursed, as is the builder, with the myriad inconsistencies and irritations of local by-laws and parochial red tape—and we shall probably sigh for the bad old days again!

If we are to avoid Government interference; if we would at least limit it to the assistance which probably we shall find eventually necessary to enforce whatever scheme we may devise to rid our trade of the shame and danger of shoddy wiring; it behoves us now to act, and quickly. We have reached the point where we must do something to show that we are capable of putting our own house in order, if we are not to be set aside in it.

Good! We are all agreed on that. To be sure, we have been agreed on that for years past; and here we are, still only talking . . . talking . . . and ending, as ever, with the question: "What, after all, can we do?" Who, to begin with, are "we," who are fundamentally interested?

We may rule the general public out of it. Although here and there an individual who has suffered in purse, or worse, may be temporarily excited against the jerry wireman, users and possible users of electric light and power are as a whole not only indifferent to, but ignorant of the dangers of shoddy wiring; and in any case have, failing official aid, neither the knowledge to suggest, nor the organisation to enforce a remedy.

In practice, the fire insurance companies are not interested in the problem. The great majority of their policies are on properties too large to be handled by the shoddy firms responsible for shoddy wiring. Most of that is to be found in small, cheap houses and shops which are either not insured at all or are insured for amounts which do not particularly worry the companies. They are content to adapt their premiums to their actuarial calculations, without seeking to reduce them by reducing fire risks. Their inspections of wiring, particularly in small properties, are often farcical, amounting to little more than the filling in by the contractor of an antiquated form.

Nor are the supply companies really interested. They should be, of course, if they took the long view, remembering that every fire, every fatality, enormously retards the expansion of electric service. On the other hand, they know that electricity must in time sweep all competitors from the field, and they are apparently content to wait that time without doing anything practical—from the contractor's point of view—to accelerate it. Naturally, in theory, they condemn shoddy wiring; in practice, supply companies, like sailors, "don't care." With a single eye for their load, they will connect up any and every installation they can. The more cheaply wiring can be done, the more quickly their consumers' list will grow; and in short, a high standard of wiring is against their immediate interest. Their service cut-outs protect their mains; and so long as their meters are adequately safeguarded, their interest in what lies beyond is perfunctory. There are exceptions: there are companies which have by-laws empowering them to condemn a faulty wiring job. They are hardly likely, however, to be rigidly enforced when that may mean the loss of a possible consumer. Nay, be it whispered, there are companies doing their own installation work, directly or indirectly, whose jobs would be condemned by any self-respecting contractor.

Consider next the manufacturers and wholesalers. The smaller of these make no bones about it: they will sell to Tom, Dick, and Jerry; and if Jerry assembles a shoddy job with the shoddy materials they list for his special benefit—well, what else is to be expected? The future of the industry leaves them cold; they are only concerned with present profits. The larger firms, while they pay a certain lip-service to the cause of sound

wiring, are actually little better. They may be more chary of opening accounts with cheap-jacks; but only because they know that bad work is usually associated with bad debts. If Jerry cares to pay cash, he can have what he likes and do what he likes with it. And in justice, they can scarcely be blamed for their attitude. They can hardly be expected to examine a prospective customer on his technical attainments; still less, to sally forth to pass judgment on his performances. It is clearly no business of theirs. We can expect no help from them in our task of stamping out the shoddy contractor—unless, perhaps, their blessing.

We can expect no more from the consultants and architects. The consultant very naturally flatters himself that his specifications are only sent out to firms of repute, and that in any case he can enforce his standards, even if—as not infrequently happens—the firm who secures his orders does so at a price which could only be based on more or less shoddy wiring. The same argument applies to architects of standing, whether they employ a consultant or issue their own specifications. The smaller architects, with little or no electrical knowledge, are no more to be counted on for interest or assistance in our problem than the general public.

So in the end we are left, as was to be expected, with the one body whose interests are directly affected by the prevalence of bad work: the electrical contractors themselves. It is the electrical contractor, and he alone, who suffers, personally and in the present, from the unfair competition of irresponsible jerry wiremen; it is he who most feels the definite curtailment of turnover which follows the bad effects on the public of reported fires and fatalities: and it is he as a class who has to bear the odium of the crimes committed by the tinkers and plumbers and "handy-men," here to-day and in Carey Street to-morrow, who masquerade under his honourable name. He can expect no help from the other members of the trade. He must work out his own salvation, or be damned by encroaching circumstance; and he must do it *now* if he would not linger to be throttled in the grip of officialdom.

To speak of the electrical contractor is to speak of his representative body, the E.C.A. It is obviously only to the Association that we can look for guidance and action. And it can only act efficiently if it has the whole-hearted co-operation of its members. The apathy of so many, who leave everything to a few devoted committee men and only remember them and their workings when they see an occasional N.E.C.T.A. rebate note, will, if now persisted in, surely prove fatal to the whole future of the industry. On the other hand, if every laggard member will make up his mind to devote some of the time and trouble he has so long owed the Association to the prompt suppression of the jerry wireman and his shoddy tricks, the problem will be solved, and speedily. It *can* be solved.

The E.C.A. has, in its scheme of registration, its associated body, the N.R.E.I.C., an instrument, roughhewn, admittedly imperfect, but certainly capable of improvement to our present purpose. It is to the expansion and strengthening of the Register; to the securing of a certain meed of Government co-operation —not impossible; and finally and chiefly, to the intensive education of the public, that we must look for the removal of this stigma—of shoddy work—from our industry; and each of these avenues to salvation calls for a careful exploration.

(To be continued.)

Series A.C. Transmission.

The author discusses the possibilities of, and presents a scheme for, the distribution of a.c. electrical energy in "thin" areas by means of a constant-current primary ring-main circuit with variable-current secondary or load circuits.

By HENRY M. SAYERS, M.I.E.E.

(Concluded from page 50.)

SERIES transmission as herein sketched might be more economical than parallel transmission for rural districts where a number of comparatively small loads are scattered over a long route. In the first place, the switchgear at the sub-stations would be simpler and cheaper. No current-carrying circuit has to be opened to switch out a sub-station or transformer set. To switch out, the line terminals would be first short-circuited and then the transformer connections opened. It might be found advisable to put a substitutional resistance across the line terminals and cut this out gradually after opening the transformer connections. No circuit breakers or fuses would be required on the line or primary side. A short circuit on the primary side could have no serious effect in the way of large current surges on the supply or the line; it would simply amount to cutting out the sub-station. Reactance protection of the line against line shorts would be given by the transformer primaries in series; a terminal reactor—which might be the inherent reactance of the supply plant—might be advisable for protecting against "shorts" near the station. There would thus be a substantial saving in sub-station switchgear as against that needed in the parallel system where a sub-station breaker may have to deal with a large fraction of the whole system power.

Again, there would be no voltage-regulation difficulty on the line side. The farthest sub-station would get as good voltage as the nearest, and consequently the line construction would be designed for the maximum economy without limitation by voltage-drop considerations, either in respect to distance or amount of load; the conductor section would be uniform throughout the line. It is true that the line losses would be constant over the 24 hours, but as these losses would have 100 per cent. load factor, and could be calculated for maximum economy, this does not seem to be a serious drawback.

Any single-phase line must be a loop; it could go out by one route and back by another, picking up sub-stations both ways. Three single-phase lines with equal numbers of sub-stations on them could converge at their ends and so form a star circuit, so that the single lines could not be topographically loops. A single-phase loop could be converted into a star by building another line on another route to its mid-point, trebling the line capacity by a 50 per cent. addition to line cost, with one half of the added capacity on the new route. This seems a useful point for "thin" areas where the growth of the load is expected to be slow. For areas wherein the consumers are grouped in villages, and so on, three phase lines might be preferable. The low-pressure distribution in these cases would be four-wire, three-phase. The sub-stations would not need constant attendance, and failure of the regulating gear would have to be safe-

guarded by a cut-out for excessive voltage; *e.g.*, one of the film or Cardew type.

A point of perhaps minor importance is that the pressure to earth or neutral would diminish outwards from the supply source, so that only a fraction of the insulators would be under maximum stress. As an example, assume a supply pressure of 33,000 V, three-phase. This would allow of 15 sub-stations at 2,000 V primary, plus 3,000 V for line drop on the loop. At 10 A per line each sub-station would have a full-load capacity of 60 kVA input, or a total for the whole loop of 900 kVA. The stations might be strung along a loop 30 miles in length, and the line wires be of 200-lb. copper—the minimum size permitted—each having a resistance of about 130 ohms, making the ohmic losses about 39 kW, or about 4.3 per cent. of the full load. Such a three-phase line would be about as cheap as could be built. In such a case it is clear that the l.p. distributors could cover the whole length of the line for a width of two or three miles.

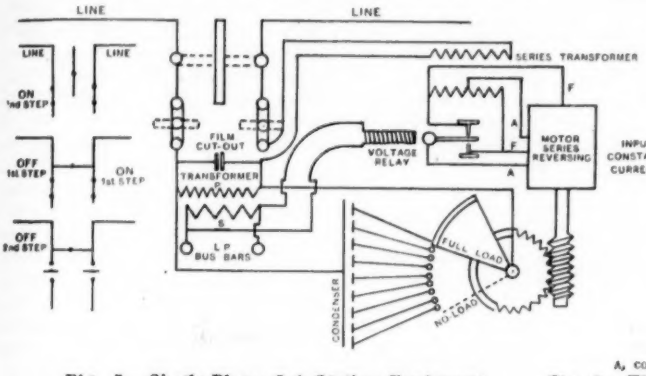
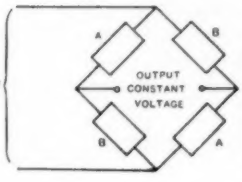


Fig. 5.—Single-Phase Sub-Station Equipment.



A, condensers; B, inductances.

Fig. 6.—The "Boucherot" Network.

It should be noted that the sub-stations on any line need not be of uniform capacity; they might be of varying capacity with different primary voltages. Growth of load on any sub-station could be met by putting in a second or larger transformer. The larger transformer would be wound for a higher primary voltage and a larger winding ratio. The condenser compensator, it may be noted, becomes smaller (fewer microfarads are needed) as the primary pressure is increased.

Fig. 5 is a diagram of the connections and apparatus for a single-phase sub-station.

Consideration of Mr. A. C. Bartlett's paper on "Boucherot's Constant Current Networks" (*Journal*, I.E.E., March, 1927) shows that the bridge circuit—fig. 9 of that paper, reproduced here as fig. 6—will give a constant-voltage output from a constant-current input. It is inherently automatic, requiring no regulator or moving parts, and if it could be realised in a commercial form with reasonable efficiency it might be superior to the arrangement outlined above; the magnitudes of the condensers and inductances required in the Boucherot bridge seem to be commercially practicable. Each of the two condensers would have to be of the maximum capacity required for the variable condenser in my scheme, and each of the inductances of reciprocal value. There would be inevitable ohmic losses in the inductances, and the arrangement is rather sensitive to variations of frequency. Reciprocally, a constant-current supply could be obtained through a Boucherot network from a constant voltage, also inherently automatic. The question whether these networks could be realised on the scale required at practicable cost and efficiency seems worthy of attention, which at present the writer has not given it.

This article is intended to suggest consideration of what seems to the writer a practicable method of supplying "thin" districts economically. There might be an application of the constant-current principle on a very different scale. It is well-known that there is a difficulty in maintaining the stability of very long transmission lines carrying a variable load (see, for example, Mr. F. H. Clough's paper on "Stability of Large Power Systems," *Journal*, I.E.E., July, 1927). With a constant current, however, such a line is stable. It seems, therefore, that by using current-controlled regulation at the source, and voltage-controlled regulation at the delivery end, by the application of either static or synchronous condensers, greater stability, and perhaps better utilisation of the line capacity, are attainable. The arrangement seems particularly applicable to lines feeding a number of distributing points on the route.

The American practice of using synchronous condensers on long transmission lines may develop into working them at constant current, if it has not already done so; this is a more complex question than can be dealt with here.

The writer recalls a remark from Mr. W. M. Mordey (past-president I.E.E.) in one of the "system" discussions of forty or more years ago: "Nature favours uniform current in any electric circuit; it is definitely against a uniform voltage over a network."

Lighting Measurement.

The Determination of Mean Spherical Candle Power by Means of the Rousseau Curve.

By G. W. STUBBINGS, B.Sc.

THE determination of the mean spherical candle power of a light source, or of the total luminous flux proceeding from it, is often made by measuring the average intensity in a number of directions inclined at various angles to the vertical. From these measurements the polar curve of intensity can be plotted, this curve being symmetrical about a vertical axis, and possessing the property that the length of a radius vector in any direction is proportional to the average intensity in that direction. The curve so drawn does not enable the average intensity to be determined directly, although it gives a useful visual indication of the nature of the intensity distribution.

In fig. 1, let o be a source of light, and let a sphere of unit radius be described round o, the half section of this sphere by a vertical plane through o being RXQ. In any direction ox, the average intensity over the surface of a thin slice of the sphere containing the point x is GL, the intersection of ox with the polar curve of light distribution. The total flux of light through the bounding area of this slice is equal to the product of the intensity and the area, and it is easy to see that this area is

not proportional to the angle subtended by the strip at the centre of the sphere. The area of a 10-degree slice will, for instance, be a maximum in a horizontal plane through o, but will be very small at the vertical axis. It is not difficult to see that the length of the arc of the circle bounding the section of the slice bears the same relation to its thickness as the radius of the sphere bears to the radius of the slice. Since the area of the slice is equal to the product of the length of the arc bounding

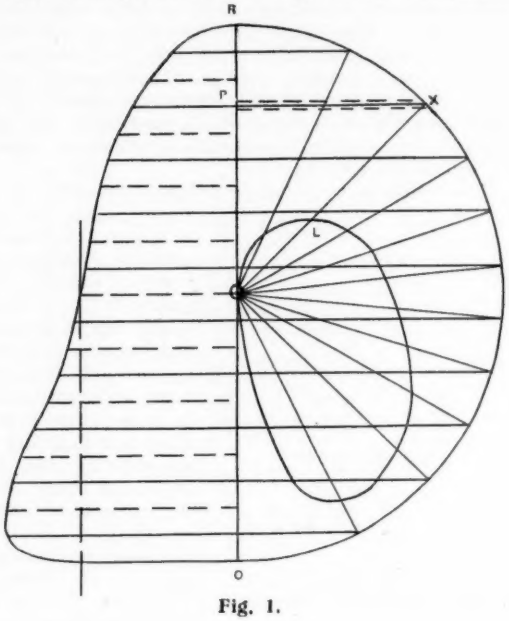


Fig. 1.

the section and the average circumference, it follows that this area is equal to the thickness of the slice multiplied by the circumference of a great circle of the sphere, and that the area of a slice of the sphere depends only on its thickness and not on its distance from the centre.

If now the values of the intensity be plotted against the projection of the radii of the sphere on a vertical axis, corresponding to these intensities, we obtain the curve shown to the left of fig. 1. This is the well-known Rousseau curve. In this curve the area of a horizontal strip is equal to the product of the thickness of a horizontal slice of the sphere and the intensity round the boundary of the slice. We have seen that the area of the slice is proportional to its thickness, and it thus follows that the area of a strip of the Rousseau curve is proportional to the flux of light through the bounding area of a corresponding slice of the sphere. As the vertical height of the Rousseau curve is equal to the diameter of the sphere, the aggregate of all the strips making up this curve corresponds to the totality of slices forming the complete sphere. The area of the Rousseau curve is thus proportional to the total flux of light, and its mean horizontal ordinate is equal to the mean spherical intensity.

If we proceed to find the area of the Rousseau curve by the usual mid-ordinate method, we divide this curve into a number of strips, say ten, and determine the average of the intensities at the mid points of these strips. It is easily seen that these intensities correspond to those in directions which are inclined to the vertical axis at such angles that the distance between the projection of the radius of the sphere P and the extremity of the vertical axis R is equal to 0.05, 0.15, and so on, of the diameter of the sphere, or 0.1, 0.3, and so on, of its radius. The ratio of the distance PR to the radius is evidently $(1-\cos\theta)$, where θ is the inclination of the radius vector OX to the vertical, and the required directions will therefore be such that the function $(1-\cos\theta)$ is equal respectively to 0.1, 0.3, 0.5, 0.7, and 0.9. The values for $\cos\theta$ are therefore 0.9, 0.7, 0.5, 0.3, and 0.1, and from tables the angles are found to be 23.8 deg., 44.6 deg., 60 deg., 72.5 deg., and 84 deg. in the upper quadrant, the directions in the lower quadrant being symmetrical with those in the upper. If therefore the intensity be directly measured in each of these ten directions, the average of them will give, to the appropriate degree of approximation, the value of the mean spherical intensity, for each of the measured intensities gives the average over slices of the sphere of equal areas. The necessity for plotting a polar curve or a Rousseau diagram is thus avoided. If greater accuracy is required, the equivalent of twenty strips of the Rousseau diagram can be obtained by determining the intensities at angles with the vertical whose cosines are 0.95, 0.85, and so forth. The use of these series of angles was first pointed out by Dr. Alexander Russell, and is usually called by his name.

The Constant-Potential System of Accumulator Charging.

The author discusses the pros and cons of the constant-pressure system of charging, and describes the methods which he has found successful in practice.

By T. C. GILBERT.

I WAS very surprised to note in a recent article on accumulator charging in this journal, from the pen of a well-known contributor, that there was no reference at all to the constant-potential system of accumulator charging. As this method is slowly but surely coming to the fore in this country, and is almost universally used in America, I do not think it should be left out of any consideration of methods whereby accumulators may be charged. I myself have used this method successfully for the past three years, mine having been amongst the first few firms to install it in this country, and this article is intended to be a guide to others who may be considering the installation of a constant-potential system, and to whom another's experience of the advantages, and limitations, of the method will be useful.

Violent discussion raged in the American technical Press during the early part of 1924 concerning the merits and demerits of the constant-potential method of charging, and can be found by those interested in the *Automotive Electrical Engineer*, Vol. 3, No. 7, for March, 1924, and Vol. 3, No. 8, for April, 1924. I was especially interested in the correspondence, as it was during that period that my firm decided to adopt this system.

A brief recapitulation of the arguments for and against it will be useful, in order to ascertain how far they are borne out by our practical experience, not only of the straight constant-potential system, but also of the modified system that is mentioned.

Dr. Woodbridge acted as protagonist for the constant-potential system, and gave very simply and clearly the

reactions occurring in storage batteries during charge and discharge. He stated that at the commencement of a charge all the active material in the cells was more or less sulphated, and, as shown by its low specific gravity, the electrolyte was weak. At the beginning of the charge naturally the most accessible parts of the plates were acted upon by the charging current, resulting in the production of strong sulphuric acid in the pores of the plates, which then became diffused into the electrolyte. Dr. Woodbridge states that the presence of this strong sulphuric acid in contact with the active material of the plates causes the counter-electromotive force of the cell to rise above the value corresponding to normal acid density. As the charge proceeds, the more remote and less accessible portions of the active material in the plates must be reached by the charging current, and the strong acid thus produced cannot so readily be diffused, so that one of two things must happen: either the acid density in the pores of the plates must become greater in order to maintain the same rate of diffusion, or the charging current must be reduced to correspond with the lower rate of diffusion which is possible with the same acid density in the pores of the plates. It follows, therefore, that as the charge proceeds, either the charging voltage must be increased, or the charging current must be reduced.

Another phenomenon may be observed during the charging of a storage cell. If the charging current is increased by raising the applied voltage, a point will be reached when the whole of the charging current cannot be utilised to recharge the active material in the plates, and the excess current merely decomposes the water in the electrolyte into its constituents, oxygen and hydrogen, which appear in the form of gas bubbles on the positive and negative plates respectively. According to Faraday's law of electrochemical action, a given quantity of electricity passing through an electrolytic cell will produce a definite amount of electrochemical decomposition and no more. It will be apparent, therefore, that any current expended in decomposing the electrolyte is absolutely wasted and has no effect in charging the plates. Also, should this gassing become excessive, it is liable to damage the plates by loosening or even dislodging active material, and charging rates sufficiently high to produce excessive gassing usually produce an abnormal amount of heat in a cell.

It thus follows that to obtain satisfactory results the charging rate should always be kept below the point at which excessive gassing takes place, and it will also be noted that as the charge proceeds, the maximum rate that can be used without gassing becomes lower and lower, until, when the battery is fully charged and there is no longer any active material which can be acted upon, all the current is expended in producing gas. Dr. Woodbridge states that it will be found that if the rate of charge throughout the charge be maintained at a point just below that at which appreciable gassing takes place, the voltage maintained across the cell terminals will be practically constant and equal to a value between 2.3 and 2.4 volts per cell. The exact value will depend on the temperature and specific gravity of the electrolyte and also to some extent on the age, condition, and design of the plates. Lower voltages may be used with satisfactory results, but obviously the time required for a complete charge will be proportionately greater.

It will thus be apparent that if a suitable charging voltage is applied to the terminals of a battery and kept constant for the whole period that it is applied, the battery will receive a charge in minimum time at high efficiency, without excessive gassing or undue temperature rise.

This method of charging is known as the "straight constant-potential" method, and in order to be successful it is essential that the applied voltage be kept practically constant, as even small variations will mean large variations in the charging current. It is often difficult to obtain this accuracy of charging voltage under changing or variable loads, but there are machines on the market to-day which do satisfactorily solve this problem, and one such machine will be described later. To illustrate the absolute necessity of keeping the applied voltage constant, it has been noted that in some cases a voltage rise of 0.25 volt means an increase in charging current of between 4 and 5 amperes.

At the same time it is necessary to have some means of controlling the applied voltage outside the machine, as it will be obvious that during cold weather a slightly higher voltage will be required to fully charge a battery, compared with the voltage required in warm weather.

The use of the straight constant-potential method involves comparatively high charging rates at the beginning of the charge, and if a number of discharged batteries are connected at the same time, care must be taken that the total current demanded does not exceed the capacity of the charging source.

The various difficulties enumerated above will indicate that the straight constant-potential method requires skilled supervision, and while the difficulties are not serious, they may be completely eliminated by the use of the modified system of constant-potential charging. In this system it is still required to maintain a practically constant voltage on the charging bus-bars, but this must be somewhat higher than that employed in the straight constant-potential method. A small fixed resistance is then inserted between the bus-bars and the battery, the effect of which is to limit the initial charging-current values; towards the end of the charge the effect of this resistance is, of course, not so marked, owing to the fall in the current value.

The general opinion in America seems to be in favour of this modified method, although after three years of use it seems to the writer that the difficulties attendant upon the use of the straight constant-potential method are much exaggerated. We have successfully used a combination of the straight and modified methods, which has given ideal results, and will be fully described later. Certainly the modified method used exclusively eliminates the necessity for skilled supervision, but as such supervision is usually available in a charging station of any size its avoidance would not appear to present any great advantage.

Dr. Woodbridge points out that while satisfactory results may be obtained with an applied voltage equal to 2.45 volts per cell and with a resistance of 0.008 ohm in each charging circuit, in general a higher voltage and a greater amount of fixed resistance in each charging circuit will call for a somewhat greater time for completing the charge, but will be safer and require less adjustment and supervision. He also points out that the method is subject to abuse and misunderstanding, that it is not so easy to determine when a battery is fully charged by this method as with the constant-current method, and that batteries in bad condition must be weeded out as soon as possible after they are put on charge, to prevent injury from excessive temperature rise. These difficulties he does not consider serious, and he claims that the success of the modified constant-potential method is well established, and that American service stations are being rapidly equipped with specially designed apparatus.

It will be remembered that this statement was made in 1924, and Dr. Woodbridge's opinion has been completely endorsed by the vast number of battery service stations in America now using this method.

Before going on to consider our own plant and its operation, it will be interesting to give a brief outline of the objections raised against the constant-potential method in 1924, and to see how far these objections have been borne out in our own experience. The chief opponent to the constant-potential method in the discussion mentioned above was Mr. Holland; his objections are that its success depends first upon the equipment purchased, and secondly, upon the care and intelligence exercised in the use of such equipment; that the danger lies in believing that such charging is automatic, and requires little or no supervision, when it is obvious that more will be required when batteries are charged at a high rate of current. Battery temperature in parti-

cular must be watched, and specific gravity observed frequently; also considerable judgment must be used with regard to placing batteries on charge, because it is very easy to overload the machines and blow fuses by starting to charge a number of discharged batteries at one time. He is therefore opposed to 8-hour charging by constant-potential methods on account of the close supervision required to make it safe. Charging in 16 or 20 hours achieves the same result, *viz.*, that a customer can get his battery the next day. He deprecates the constant-potential method for the initial charge of new batteries, as, regardless of the kind of separators used, new plates are apt to suffer from high charging rates during the initial charge to an extent which may not be apparent at once, but is more likely to shorten the life of the battery. (It may be stated here that we quite agree with this last point of Mr. Holland's, although, in any case, Dr. Woodbridge does not advocate the constant-potential method for new batteries.)

Mr. Holland also deprecates the use of this method for the recharging of badly sulphated batteries, or repaired batteries in which plate replacements have been made, contending that the old method of charging such batteries in series with a low current is better and less troublesome (again we agree). He thinks that car batteries will eventually be charged by a considerably modified form of constant-potential method, using an applied voltage of about 16 volts for 6-volt batteries, and a small amount of fixed resistance, taking the form of battery leads used in each individual charging circuit. This last opinion has not been borne out in practice, and in any case I consider the idea quite unsound. It is reasonable to assume that if the fixed resistance takes the form of battery leads, heat generated in these leads will be readily transmitted to the battery itself, possibly with serious consequences.

I think we may safely leave the theoretical discussion here and come to the equally important practical application. It will be obvious from the foregoing that at least a certain amount of supervision and discrimination will be required in order to secure the full benefits of the constant-potential method, and also that this system cannot take care of the whole of the battery charging, but will only be used for the recharging of healthy batteries.

Whatever type of equipment is purchased, the following points should have careful consideration; generally speaking, it is safer to use a shunt-wound generator, as compound generators are apt to reverse in polarity under certain circumstances. No matter what type of generator is used, the set should have a reverse-current cut-out fitted to prevent the batteries discharging into the generator should the driving power fail. High-grade voltmeters, &c., should be used and field rheostats, if any, should be capable of fine adjustment.

A description of the plant we are using is as follows: The motor-generator is by the Crypto Company, with common field and double-wound armature. The input voltage is 210 volts, direct current, and the output is 120 amps. at 15 volts. The machine has ball-bearings, and is efficiently ventilated by a fan mounted on the armature shaft. A suitable starter is supplied and a switchboard to control the output with voltmeter 0-20, ammeter 0-120, s.p. switch, s.p. fuse, and Crawley type auto cut-in and cut-out.

The Crypto Company manufactures these machines in various sizes, and with either 7½-volt or 15-volt secondary. We are using the 15-volt pattern, as otherwise it would not be possible to recharge 12-volt car starter batteries, of which there are several makes. The ordinary 6-volt wireless batteries are placed on the bars two in series, and although the pairing of suitable batteries calls for a certain amount of discrimination, we find that, provided batteries are of similar capacity and that the specific gravity of the acid is correct, there is no great difference in internal resistance between various makes. We try to pair as far as possible batteries which have been apparently discharged to the same voltage, that is to say, with similar hydrometer readings.

It should be noted that there is now marketed a machine with a 3-wire output giving 7½ or 15 volts. This was not available when we purchased our machine about three years ago, but it would appear to provide the ideal arrangement and avoid placing batteries in series.

By far the bulk of our accumulator charging consists of healthy 6-volt 30- or 40-amp.-hour batteries, the majority of these being "Exide" or Peto & Radford batteries, which we have sold to customers ourselves. Our usual method is to start up the machine and then commence to connect the pairs of batteries to the bars, a pair at a time. This operation need not take up much time, as we use the "Exide" battery clips both on batteries and bus-bars, and it has the advantage that the operator can watch the ammeter and instantly disconnect any pair of batteries which causes, in his opinion, any undue current rush, and put them aside for examination.

The secondary voltage of the motor-generator is quite constant, irrespective of the load, and this without any external regulation at all, being perfectly automatic. Variations in the line voltage will, of course, cause changes in speed with corresponding fluctuations of the secondary voltage.

As we were troubled with very unsteady line voltage when we first used the constant-potential method, we were forced to carry out our charging during the night, from 10 p.m. to 8 a.m.

Conditions have now been very much improved; our line is usually a volt or two over normal, and we have inserted a regulating resistance in the armature circuit of the motor which enables us to keep our secondary voltage absolutely steady, and also make the slight adjustment for summer and winter conditions.

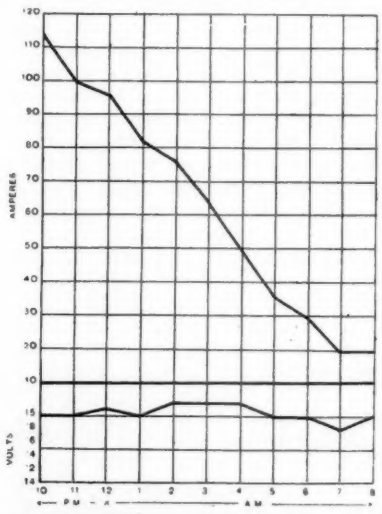


Fig. 1.—Falling Battery Charging Rate, and Terminal Voltage.

Batteries are carefully watched during the first hour or so for any undue temperature rise, any doubtful batteries being taken off the bars at once and the trouble investigated. It is almost impossible for a battery with one cell shorted or reversed to get on the bus bars, as the excessive current rush at once indicates the presence of the fault. In the case of new batteries, or those for some reason or other requiring a slow charge, we pair them with a charged battery and leave them on the bus bars for several runs. We have, however, placed new batteries direct on the bars, completing their charge in the night run, without any apparent damage to the batteries. The heaviest current rush occurs with totally discharged, but healthy, batteries, as much as 15 amperes passing through a 6-volt 40-ampere-hour (actual) battery; this current, however, only flows for a matter of minutes, rapidly falling to a more reasonable amount, until at the end of the first few hours the current is somewhere about the normal charging rate, falling therefrom practically to zero at the end of the charge.

New batteries when placed direct on the bus-bars take about their normal charging rate for the first hour or so, the current rising later to a somewhat higher figure, perhaps double or treble their normal rate, from which it falls away to zero at the end of the charge.

At the completion of the charge the batteries are disconnected, a pair at the time, before the motor-generator is shut down, to prevent the possibility of any inter-discharge of the batteries, although it is difficult to see how this could occur. The fine healthy colour of the plates is usually sufficient evidence of the completeness of the charge, but the specific gravity of the acid of every cell is carefully tested. It is very rarely that a battery has to receive any further attention at all, and is not ready to go out at once.

The accompanying chart taken at random from our log shows the falling charging rate, the readings being taken every hour. The slight fluctuations in voltage are obviously due to line-voltage variations, as there are no corresponding current variations.

The voltage can easily be read to these fine limits, as the scale is extremely open at the working end.

The load is stated on the chart to be 850 ampere-hours; assuming this to consist of 6-volt 30-amp.-hour (actual) batteries, there would be 28 batteries on charge. As they are connected to the bus bars in pairs in series, the commencing charge rate through each cell is $114 \div 14$ = approximately 8 amperes.

This commencing rate probably fell off quicker than the chart shows, as the next reading was not taken until an hour later, which shows it to have fallen to approximately 7 amperes, and at this stage several other batteries were placed on charge. It takes about six hours for the charging rate to drop to the normal 3 amperes, still assuming the load to consist of 6-volt 30-ampere-hour batteries, but after this is falls away rapidly. At the end of the last hour the ammeter is probably at zero, but the scale divisions are difficult to read here, and we have instructed our attendants not to assume zero reading until the end of the charging period, which accounts for the small reading plotted on the chart.

This chart is dated March 23rd, 1925, and shortly after this date we discontinued the use of logs of any kind, as the system proved itself to be absolutely reliable and needing far less supervision than we had expected. It is now no uncommon thing for our operator to leave the plant completely for two or three hours at a time.

In this district we naturally get the same batteries in for charging over and over again, and in some cases as often as twice in one week. As stated before, the majority are "Exide" and Peto & Radford, and have been supplied by ourselves, and in several cases they have known no other method of charging but the constant-potential system. Our plant has now been in operation for three years, and I have never seen a healthier-looking lot of batteries in all my experience than those which go out from our charging station every morning. As there is practically no gassing on charge, there is no spraying of the electrolyte, and consequently no corroded terminals. There is practically no deposit at the bottom of the containers, unless it was there before we took over the charging of the battery; no signs whatever of buckling, sulphating, or any of the ills that accumulators are heir to; in fact, the batteries are a delight to look at with their perfectly coloured plates, clean cases and terminals. Frothing is unknown.

Another advantage of the method is that with a charging voltage of 15 volts there is no risk of shock to the operator in handling batteries on charge. The fire risk is also decreased, as the breaking of a current of 5 or 6 amperes at 15 volts during the disconnection of individual batteries produces no arc at all, whereas the same operation at a high voltage such as is employed in the constant-current method is attended with considerable risk if celluloid-cased batteries are on charge.

We are now averaging something like 150 batteries per week, and complaints of undercharging are practically nil; if one occurs, we know at once that it is the fault of the battery and not of our charging. We naturally get all sorts and conditions of batteries in for recharging, and it is sometimes necessary to correct acid gravity or otherwise get the battery into condition before it will take kindly to the constant-potential system.

Another great advantage of this method is the fact that any size of battery can be fully charged in the period we allow, that is to say, 10 hours. The largest car starter batteries under the old system took us a matter of days and cost big money to recharge from the mains; now we can get them all out in 8 to 10 hours.

The running cost of the equipment can be gauged from the fact that when our machine is fully loaded, delivering 120 amps. at the secondary, the motor is drawing about 10 amperes.

It is interesting to note that we do not use the resistance leads advocated by Dr. Woodbridge, but place our batteries direct on to the bus-bars. In fact, we take every precaution to prevent voltage drop in the bus-bars by using heavy copper bars fed in the centre by heavy cables from the switchboard terminals. Low-pressure rubber-insulated car flexible is used between the batteries and bus-bars, as we find this stands up well to continuous handling.

We do on occasion use a resistance between the bus-bars and a battery or batteries should it be required to reduce the initial heavy current owing to heating of terminals or lead cell-connecting strips, a trouble not uncommon with one particular make of battery, owing to the small section of the lead strips employed.

We also use small ammeters for placing in circuit with any doubtful batteries to check the charging rate to these particular cells more easily than can be done by means of the main ammeter. We do not attempt to charge decrepit or badly sulphated batteries by the constant-potential method, nor do we employ it for the recharging of special cells, such as the "Exide" D.T.G. or D.F.G.

From our experience of the constant-potential method of accumulator charging, we unhesitatingly recommend it to any engineer who is faced with the problem of charging large numbers of batteries quickly, completely, easily, and cheaply, provided that such supervision can be applied as will ensure full advantage being taken of the benefits of the system. We have had one man in charge of the plant since its installation, and although, as pointed out, he occasionally leaves the machine entirely unattended, it is experience of the system which enables him to judge at which times it is perfectly safe to do so, and it must by no means be assumed that it would be safe with a less skilled operator.

Local conditions, such as variable supply voltage, and the types of batteries to be recharged, will in a great measure determine the degree of intelligence required for efficient supervision.

Central Heating from Electricity Works.

In the *Génie Civil* for January 7th an account is given of the public supply of steam for heating at Utrecht, Holland, a city of 130,000 inhabitants. It is pointed out that as old power stations situated in populous districts are superseded by large external stations, the former are sometimes retained to serve as stand-by plant and to help during peak loads, and it is desirable to increase their "coefficient of utilisation" as much as possible. The old station at Utrecht is close to several hospitals, the University laboratories, office buildings, and the central railway station, so that the conditions for the sale of heat are favourable. Saturated steam is produced by three boilers at 150 lb. per sq. in., and by a water-tube boiler at 220 lb. per sq. in., superheated to 350 deg. C.; the latter is led into a cooler where cold water is injected into the steam, reducing its pressure and temperature. From a drum receiver the steam is distributed through underground pipes in concrete ducts to the consumers. The central hospital and the railway offices are heated by hot water, which is heated by the steam in counter-flow apparatus. The output in 1926 was at the rate of 55 million kg. of steam per annum, the sale price being 11d. per unit of 100,000 calories, with coal at 20s. per ton.

Completing the Work.

C.E.D.A.C.—Retrospect and Prospect.

By V. W. DALE, Business Manager of the British Electrical Development Association.

THE least that can be said of "C.E.D.A.C." is that its foundations have been well and truly laid. Money, material and personnel have contributed generously and combined effectively in the early stages of this effort which, it should be remembered, not only engaged the earnest investigations, but was sealed with the complete approval of all organised sections of the electrical industry many weeks before the work actually commenced.

Nothing could induce the writer to claim that everything has proceeded satisfactorily—permanent progress and development are not to be found in the paths of the satisfied. Satisfaction breeds inertia. But it must be conceded that the electrical industry has, on this occasion, responded splendidly to the Association's appeals for moral and financial support as no other industry has ever done in this land of notoriously bad co-operators.

In passing, if anyone reading these lines feels conscious of securing unmerited credit from the generic use of the expression "industry," it is to be hoped that he will take pains in the later stages of the Campaign to fill in any omissions. It is by no means too late.

C.E.D.A.C. in Retrospect.

The scheme of the E.D.A. Circle Campaign was visualised in the first instance from a *national* standpoint, and, in fact, it is an essentially *National* Campaign ingeniously planned to adapt itself immediately to *local* development work irrespective of the class of business desired for the time being by any section, undertaking or firm. In other words, the Campaign was designed to boost electric cookery and heating and water heating in cheap electricity areas; small current-consuming appliances in areas not ready for bigger development; and the wiring of old and new property and the general advantages of domestic electrification in *all* areas. Essentially, therefore, to test the efficacy of the Campaign it must first be regarded nationally and only to a lesser extent locally.

The claim that the foundations of the National Campaign have been well laid is certainly true as regards the industry itself. As to its effect upon the general public, unquestionably definite progress has already been made. How far that progress will be reflected in the current year's trading accounts of individual undertakings and firms in all sections of the industry it is impossible either to state or forecast with any degree of accuracy. Educational work, advertising and propaganda are like the mills of God—they grind slowly, but if their scheme of things is right in conception, construction and execution the right kind of results are inevitable. It is not an easy matter to connect and correlate with exactitude the precise relationship of the functions of sowing and reaping, but only a completely incurable cynic will deny the existence of cause and effect in electrical as in any other form of progress. Broadly, it must be admitted that the readier receptivity of the British public to electrical propositions in home, business and industry is due, in a large measure, to E.D.A.'s publicity campaigns. Apart from this, there is definite evidence of acceleration in new connections and in the use of electrical energy, particularly for domestic purposes, during the last year or two. Do not, therefore, let us permit parochialism to narrow our vision of the national response which is accompanying our co-operative efforts. If, as a result of a parochial survey, C.E.D.A.C. appears narrow and anæmic, maybe it is in the "parish" itself that something is wrong. The solution is obvious.

In order to determine what remains to be done, let us review, briefly, what has been accomplished to date, bearing in mind that E.D.A.'s two major objects in this particular Campaign are:—

(1) To stimulate inside the industry increased and general enthusiasm for electrical development.

(2) To create a demand for electricity and electrical appliances at the consumer end.

By E.D.A.'s own efforts, with the help of its Committees and Circles and by the ever-ready and generous assistance of the technical Press, the C.E.D.A.C. flag has remained secure to the mast during the past six months; this Campaign has certainly enjoyed the active and very real support of more willing helpers than any previous E.D.A. Campaign.

And towards the public: During the early days of October the President's National Electric Message appeared at full column length in many of the principal newspapers published all over the country; leading articles and editorial references were accorded most generously to it. The luncheons held simultaneously in thirty-four large cities and towns provided a new and unique form of propaganda, and the excellent lay Press constituted a very valuable contribution from the newspapers to electrical development.

Subsequently, the Association's advertisements have appeared on nine successive occasions in papers and magazines covering the entire country. This advertising has been very generously supplemented by local advertising on the part of supply undertakings, contractors and manufacturers; the grand climax was reached during National Electric Week, when on top of a considerable amount of additional electrical advertising and editorial contributions, nearly one hundred composite electrical pages were published in large-circulation newspapers in the Metropolis and in the provinces. The writer doubts very much if anything approaching so intensive a Press effort has ever been made in this or any other country for a public service by those responsible for it and by those who supply the accessories for its use. In these early days it provides a gratifying demonstration of the industry's awakening to the necessity for united effort, and its recognition of the fact that educational advertising of a national character is absolutely essential to the development of a business which so closely touches an almost unsophisticated public, and vitally affects every phase of the nation's welfare.

During the National Week there were few electrical shop windows in the country which did not either exhibit the E.D.A. display, a poster or some other reference to "the Week." In addition, many other commendable local efforts were made.

During the three preceding months 240 volunteer lecturers were enrolled on the E.D.A. Lecture Service Panel; thus a valuable and more or less permanent section of E.D.A. work has been successfully inaugurated. The Association's own records, apart from engagements not advised, show that 197 lectures have been delivered, for which many excellent reports and Press notices have been secured; 96 exhibitions and demonstration houses have been organised; 612,000 pieces of publicity matter have been purchased and circulated; and, generally, the record of work done is far in advance of last year's Campaign at the same date. All of this is a credit to the industry, and especially a credit to those in all ranks who have undertaken the work regardless of personal inconvenience and expense and without looking for immediate personal reward.

So much for *retrospect*—the foundation of the C.E.D.A.C. effort.

Looking Forward.

Now for the *Prospect*—the completion of the effort.

So far the scheme has proceeded very nearly "according to plan," and the really practical work actually

remains still to be done. Everything depends upon whether "the industry" will put every ounce of its energy into the last mile to make certain the fruits of victory. The language is really not too extravagant; the prospect is very real and the rewards very tangible.

Presumably, most of us are prepared to accept the principle that all this advertising, propaganda and educational work is sowing seeds of electrical knowledge which are destined to germinate into desire for things electrical.

The scheme of the Campaign provided, after the foundation work had been done, for more personal direct contact work which, for two fundamental reasons, can only be carried out by electricity suppliers, contractors and dealers, namely:—

(1) Because the immense cost which the Association could not possibly bear at the present time, but which, spread over some thousands of large and small agencies, becomes a comparatively simple and inexpensive matter, and

(2) Because the supplier and contractor can make such contact directional and thus secure to himself as well as to the industry definite advantages.

The method which has been prescribed is neither revolutionary nor picturesque—it is just severely practical; in fact, there is a danger of its being ignored because of its utter simplicity. The scheme is this: that all potential consumers throughout the country not at present using electricity, but to whom a supply is available, should be personally canvassed or approached by means of E.D.A. publications and circular letters.

That all existing lighting consumers should be personally canvassed and persuaded to use electric heating, cooking, and labour-saving appliances, &c.; to extend their installations, to increase and bring up to date their domestic illuminations; and generally to obtain the fullest advantages from the public service of electricity and to be fully informed concerning the electrical facilities available to them in the way of rates, special tariffs, hire and hire-purchase schemes, &c.

This is personal work for all of us to do in our respective spheres and sections of the industry, and for our own personal benefit; those who fail to do their part will be throwing away the valuable advantages accruing to the preliminary propaganda and national effort. General electrical messages and appeals have been repeatedly presented to the public during the last three or four months; now the time has arrived to present direct personal appeals to every householder. This section of the Campaign should be kept up continuously during the next ten weeks, which cover a period when considerable attention is focused on improving and brightening the home.

Circles will not find it convenient to undertake this work except in cases where a whole district is completely represented on the Circle and a central fund raised for the purpose, but Circle Committees can assist the Campaign tremendously by encouraging all electrical interests associated with them to do their part.

In case any of our friends doubt the value and possibilities of direct mail advertising, let me quote two personal experiences. Last year the writer sent a letter to 10,000 schools in this country and actually received 4,000 replies. Example No. 2 is of one of our members who circulated 50s. worth of a particular E.D.A. publication and was able to trace 170 kW of additional heating demand directly to the circulars.

Prepare Mailing Lists.

Where customer and consumer card indexes or other records are not employed, a local directory should be marked up to show roads and districts where the supply is available, and, in different colour, new fields for development. In this way a rough and ready means for expeditious and economical direct mail efforts to selected sections of the community will be available.

As far as possible, "key" direct mail efforts with E.D.A. national advertisements which have still to appear; concentrate the effort with discrimination upon that portion and/or class of the public, or that department of business, which it is specially desired to cultivate, avoiding spasmodic and indiscriminate circulations.

Let it be perfectly clear that this proposal is not a complete enunciation of all the Association's resources. In the course of time further demands will have to be made—demands which will probably have in them the means for promoting more rapid development. In this article, however, the writer is dealing with a special Campaign, and has confined himself to the work which remains to be done.

If these suggestions are generally adopted throughout the industry and the lecture and exhibition services persisted in, it will be found that "C.E.D.A.C." is a power to produce in John Citizen a favourable disposition towards electrical methods and a source of profit to the industry and all those engaged in it.

A New Electric Welding Set

An a.c. outfit which, it is claimed, will maintain balance and high-power-factor during welding operations.

By C. H. S. TUPHOLME.

STATIC transformer plant is often preferred for welding installations on account of its low price, coupled with great simplicity and reliability of operation. Such plant, however, has two defects, namely, low power factor and unbalanced loading upon the primary lines, which become a great disadvantage when the supply authorities penalise low power factor.

In view of this some research has been carried on during the past months with the object of evolving some

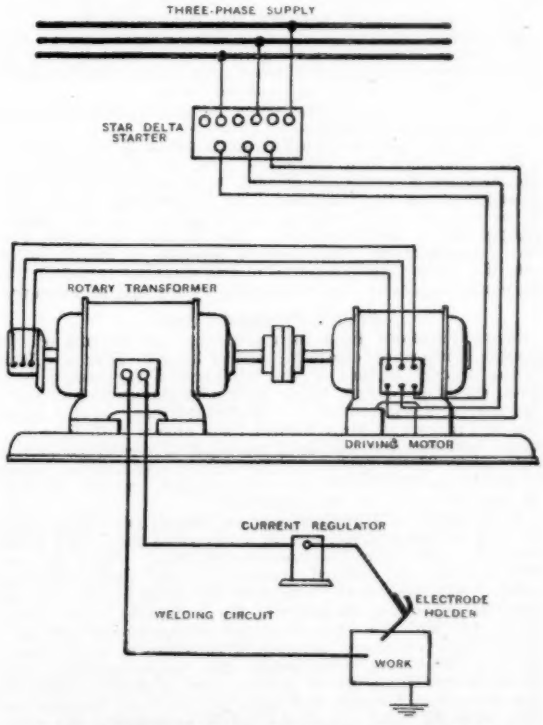


Fig. 1.—Compensated Rotary Transformer; Operating Circuit.

apparatus which will ensure a perfect balance on the mains when welding from a two- or three-phase supply, and at the same time maintain the highest possible power factor. As a result a new single welder unit has been developed which is termed by the designers a "compensated rotary transformer." This apparatus

consists, as the name implies, of a rotating transformer capable of giving a 60/30-volt a.c. supply with a drooping characteristic similar in shape to that of d.c. welding generators. Thus, although employing a.c., it is possible to weld at only 30 volts with a loading of 200 A, the conditions being perfect for all classes of welding. A small portable current regulator for the fine adjustment of the welding current down to 29 A is included in the equipment. This has a very low resistance, and the power loss is negligible under all conditions of loading. The set resembles a motor-generator in appearance, but its action is fundamentally different in that a considerable portion of the power in the welding circuit is drawn inductively by "transformer action" from the supply mains. A 5½-h.p. motor is incorporated in the set mainly for driving the rotor of the transformer member at the desired speed. This is an entirely new departure.

Reference to the diagram of connections will show that the driving motor and primary windings of the rotary are directly connected to the supply mains through a controlling starter, while the welding circuit is connected to the secondary windings of the rotary. The rotary transformer therefore constitutes a static transformer, while the motor is stationary, but as soon as the latter starts the primary windings rotate inside the secondary, inducing in them a current, the frequency of which varies with the speed of rotation.

In this way it is possible to synchronise the single-phase pulsations in the welding circuit so that the same amount of current is drawn from each of the supply lines, whatever the number of phases. Further, the rotary also acts as a generator, and can be constructed, therefore, to give a wave form which will produce perfect conditions for efficient arc manipulation.

The writer is indebted to the Quasi-Arc Co., Ltd., for permission to publish the above details with the diagram of connections.

The Overhead Lines Association.

The Use of Overhead Electric Lines in France.

AT a meeting of the Association in London on January 11th, Mr. W. Fennell presided, and announced with regret the death of Mr. C. Vernier, who, he said, had done a great deal of overhead line work on the north-east coast and would have been a very useful member of the Association. A vote of sympathy was passed.

The Articles of Association were submitted to the meeting and approved, and the chairman pointed out a slight modification in the Article relating to membership: as originally worded, only corporate members of the Institution of Electrical Engineers were eligible for full membership, but it is now left to the discretion of the Council to decide upon the actual qualifications of an applicant for full membership.

The CHAIRMAN then proposed the election of Mr. A. H. Allen, technical editor of the ELECTRICAL REVIEW, as the first life honorary member, in recognition of the services rendered by Mr. Allen in getting the Association started and generally for his work in relation to overhead lines.

Mr. W. A. TURNBULL (Aylesbury) seconded the motion, and it was carried unanimously.

Mr. A. H. ALLEN expressed his appreciation of the honour.

The CHAIRMAN then announced that the next meeting of the Association would be devoted to a consideration of the amendments of the Overhead Line Regulations which were to be sent to the Electricity Commissioners as the definite suggestions of the Association. He reminded members that the Commissioners would hold a meeting in March to go into the matter, and therefore it was essential to get in the recommendations of the Association by the end of February.

French Overhead Lines.

Major THEODORE RICH then presented an account of the position concerning overhead electric lines in France. After giving a brief account of the organisation concerning local government and roads, Major Rich pointed out that at about the time of the introduction of electricity many local authorities in France had badly burned their fingers with light railways, and the law had been modified to encourage private enterprise. There were now about 38,000 Communes in France, of which over 20,000 had electricity supplies, and in a number of areas 90 per cent. was electrified.

From 1906 to 1914 progress was very rapid, concessions being granted for many areas, and in a few cases they were taken over by Agricultural Co-operative Societies. After the war development was pushed forward in the devastated and general war zones from Dunkirk to the Swiss border, and the existing generating stations in the north-east were reconstructed. With the idea of aiding reconstruction and as a precautionary measure, two sets of Government power transmission lines were constructed, *viz.*, interconnecting lines between the larger power stations and groups of mines in the steam area between Bethune, Valenciennes, Comines and Laon at 45,000 volts, and lines at 90,000 volts linking the Swiss border water-power areas with Vincey and extending the existing line to Hirson, linking with the ironworks in the Lorraine district. Those lines were constructed at national expense; private owners of the power stations could run their stations how they liked, however, and did not have to ask the permission of any authority before they could increase their plant; they could generate power, or buy it, how and where they liked, utmost freedom being given by the State to concessionaires. In order to facilitate the utmost utilisation of seasonal peak water in the hydraulic power areas, transmission companies had been formed in the south-east and south-west, special legislation having been passed for that purpose.

Immediately after the war the Government was for a time caught with the glitter of the "national bus-bar system," which was actually started at two points, but the glitter faded. Then it was found that the demand came from the rural areas, and that the problem was not one of super-stations, daily load-balancing "grids," or national control of wholesale supplies; but of distribution capital costs—finance, not power costs; in other words, the cost from the wholesale supply point to the consumer's meter. To-day, therefore, there were some 400 power companies, or private owners, in operation, apart from Agricultural Co-operative Societies, Communes, and groups of consumers. So far as regulations were concerned, it was not so much the regulations as the spirit in which they were administered. In general, the Frenchman was good at genuine co-operation, and there were many instances in which co-operative effort had been adopted for the benefit of whole districts; for example, a group of farmers would form a limited company to buy machinery, or build wine establishments with presses, bottling arrangements, cellars, and so on. Similar societies had been formed to purchase electricity in bulk.

Before the war the French Government started to form a corps of experts to assist rural development generally, and after the war the Corps of Gènie Rurale engineers was started, and that body now gave considerable assistance in all forms of rural development, including electricity, allowance being made in the National Budget for its services. Gas companies, too, had in a number of cases been granted concessions, not only for gas supply, but also for electricity supply, the monopoly, however, usually being for electric lighting, not power. Many gas companies had started to supply electricity, and the results, on the whole, had been creditable. The present situation in France was based largely on the law of 1906, which had since been modified in detail, but very little in principle, and it was to the credit of successive Ministers of Public Works that electricity had never been made a party political "stunt." A feature of the 1906 Act was the formation of the Comité d'Electricité, consisting of 30 members, 15 nominated by Public Ministries and 15 representatives of power supply, commerce, &c., nominated by the Ministry of Public Works after consultation with the interests concerned. That Committee was a voluntary body, and membership was looked upon as an honour, and the Committee had to be consulted, according to law, not merely by the Ministry of Public Works, but by other Ministries in cases of importance. The technical regulations regarding electricity supply were drawn up in consultation with it and they had to be examined annually by the Committee. In the event of the regulations giving rise to difficulty, the points at issue were settled by the Central Committee, and in the event of the Ministries refusing to accept the decision of the Central Committee, the matter went before the Council of State, but there had been no such case yet.

Two kinds of concession were granted: one based on roadside wayleaves given by a Commune, or Departments of State, and the other when the supply was regarded as a public utility and was a more definite concession. Apart from authorised wayleave fees, a local body could not in law enforce a pecuniary charge on a concessionaire, or claim any other advantages. A public utility undertaking in France auto-

matically had easements regarding attachments to private walls and dwellings, passage over private lands which were not built upon or enclosed by walls, and passage through areas for the purpose of transport; a fixed scale of fees was payable for such easements.

Regarding regulations for electricity supply, Major Rich pointed out that there was a new series in 1924, and that the most recent was issued in April, 1927, but a valuable addendum to the regulations was to be found in a Ministerial Circular of Explanation of the same date, which took the form of instructions to the engineers and others in control. The regulations were divided into three sections, *viz.*, (1) low voltage, up to 600 volts; (2) up to 60,000 volts, or 33,000 volts to earth, 55,000 volts between phases; and (3) higher voltages. Owing to the development of the 5-kVA transformer at 15,000 volts, together with the reduction of "gadgets," that voltage was very popular for distribution, whereas in Great Britain voltages above 3,300 volts were termed extra-high-tension, a term that was ludicrously obsolete, added Major Rich, even at the time of its introduction. It was laid down that insulators should be tested for over-voltage in the makers' works, not on the line itself.

With the exception of private low-pressure branches, the minimum size of conductor allowed was 3 mm. diameter, about 11 s.w.g., 616 lb. breaking strain. As a rule 3.5 mm. was about the smallest in use, high-tension copper being in use for practically everything. Of copper conductors, 4 mm. diameter, 8 s.w.g., was a favourite section for 11,000- and 15,000-volt lines. Joints were prohibited at crossings, and although stays were not prohibited, they were not recommended. Stays were forbidden, however, for high-voltage lines in Belgium. The regulations regarding mechanical strength of conductors and works were considerably detailed, and the circular attached to them made such modifications possible, according to circumstances, that Major Rich commented on the fact that the whole of the aerial supply lines were not penalised because of certain bad places. In short, special provisions applied to special cases, and an instance was mentioned of a line at 110,000 volts from Valence on the Rhone to St. Etienne, crossing the Cevennes mountains to the west of the Rhone, where frozen fog was met with in certain gullies which settled on the conductors, freezing and building up ice at times to over 3 inches radius, and special arrangements had to be made to meet such cases.

The lowest height allowed for high-voltage conductors crossing a public roadway was 26 ft. 3 in., whilst the allowable height alongside roads accessible to vehicles was 19 ft. 7 in.; in special cases that height could be reduced; in other parts accessible to vehicles, but not alongside roads, the conductors must be at such a height as to be out of ordinary reach. Wood posts were now accepted in France for h.p. road crossings, whereas formerly steel or concrete was insisted upon. Whilst it was not forbidden to place low-voltage circuits on high-voltage posts, the latest regulations did not allow that to be done, but solely on the ground of economy. In the case of houses, low- and high-voltage lines up to 33,000 volts might be affixed thereto, provided there was a clearance of one metre from the walls and 2 metres from a roof, except in the case of a flat roof, when 3 metres clearance must be allowed; for higher voltages, 4 metres clearance was required. At important road crossings it was recommended that the spans be reduced as much as possible, and arrangements must be made that if the conductor left the insulator it would be caught, which requirement was satisfied usually by a hook attached to the insulator bracket, or by a loop. As regards earthing, for 110-115/190-200-volt lines an earth neutral was obligatory, but for 250 volts to neutral earthing was optional. Lines at over 55,000 volts, on iron or concrete posts, must be earthed. Accidents on the very-high-voltage lines were unknown, and those due to breakage of conductors very exceptional. Nearly one-third of the fatal accidents had been due to boys climbing the poles, and efforts to prevent them were being made by instruction in schools. The usual span for light high-voltage lines varied in different districts somewhat, the straightness of the road being a factor. In the ordinary way no earthing guards were required for low-voltage lines and double insulators were not general. The general rule was to keep bare wire out of reach, and insulators carrying supply lines to houses were usually placed under the eaves, insulated wire being run down on bobbin insulators and let into the houses through porcelain tubes.

As to railway crossings, it was recommended that at level crossings the overhead line should be near enough to enable the gatekeeper to keep it under observation, and special provision was made as to factors of safety of poles and conductors, distance between high- and low-voltage wires and rails, &c. As regards postal telephone and telegraph lines, the rule in France was that the first occupier of a road had first rights, and that the second occupier paid for any necessary alterations. At present, however, there was very little difficulty with the postal authorities regarding crossings, the trouble being mainly with induction from trunk lines; cases of difficulty were usually settled by the Comité. It was provided that where low-voltage lines run parallel with Post Office lines they must be kept one metre distance apart, and in the case of high-voltage lines up to 23,000 volts, a distance of 1.5 metres was specified, which could be reduced to one metre in villages. Everything was done, however, by harmonious collaboration between all parties concerned.

Major Rich pointed out that in most areas wayleaves were willingly granted on payment of the fixed fees, mainly because the farmers were able the more easily to get a supply on their farms. Finally, some details were given of the manner in which the State assisted rural electrification in France financially, *pro rata* with that provided locally, and in cases of necessity small districts were grouped together in order to provide a suitable unit for rural electrification purposes.

Major Rich expressed his thanks to Messrs. Tribot Laspière, of the Union of (French) Engineering Societies, Ourson, of the Public Works Department, Esbran, of the Socte. Parisienne d'Entreprises, Carrière, of the Société Bethunoise, Leriche, of the Paris Branch, Ohio Brass Co., and other gentlemen for assistance given in connection with the preparation of the paper.

Discussion in London.

Mr. R. A. WILLIAMSON spoke of his experience in China during the past 8 or 10 years in erecting overhead lines, and intimated that he was in the favourable position of making his own regulations with regard to them. He deprecated anything being done which would give the impression that overhead lines were dangerous, and for that reason suggested that guards, or cradles, should not be used, because, in any event, with modern construction they were not necessary. The cost of a house service on his lines was about £1 per house, whereas he gathered that in this country it frequently cost £10 or £20.

Mr. W. P. GERVAEN described in some detail the rural electrification work that is being carried out in New Zealand, where, he said, 70 per cent. of the rural area was now supplied with electricity. In one area there were 1,700 electrically-operated milking machines, and the biggest load in the future on the rural side in New Zealand would be for milking machines, cooking stoves, and water heaters. In connection with the latter an arrangement was made by which a switch in the milking shed operated mechanically to heat water during such time as the energy was not being used for the milking machine.

Mr. CYRIL D. KING said he had never yet been able to get quotations for concrete poles in this country which would justify their use.

Major T. RICH said that there was a firm in France which specialised in concrete poles for transmission lines, and had recently secured an order for 7,000 of them.

Mr. A. L. STANTON also complained of the high price of concrete poles in this country. At the same time he suggested that the conditions applying in China and New Zealand could not be taken as a criterion for Great Britain, and it was necessary to deal with this country in the light of the conditions that prevailed here.

Mr. R. A. SMITH said that when he had wished a few years ago to cross the South-Western Railway line with an electricity supply line, he was presented with four pages of obligations which he was supposed to come under in connection with it.

The CHAIRMAN said that if Mr. Smith would look up the 1919 Act he would find clauses therein which would render the four pages of obligations he had referred to so much rubbish. In that Act there were very definite and comparatively easy arrangements for dealing with such work, if only they were made full use of, but, of course, they were not in existence before the war.

Electrification in Belgium.

The Brussels correspondent of the *Financial Times* reports that the Belgian Government has drafted a Bill which, it is expected, will be introduced shortly, for the electrification of the country. It is based largely on similar legislation in force in England, and carries, as essential elements, the principle of co-operation between producers, distributors and consumers under State control within well-defined limits. Since the Belgian Parliament accepted the electrification principle in 1925, a Royal Commission has been engaged on the preparation of details of application. The recommendations of this Commission now form the proposals embodied in the Bill to be laid before Parliament, providing for the constitution of groups of producers, distributors and consumers, representing companies producing or supplying electricity, manufacturers using it, and the Government as producer, consumer and granter of concessions. Delay has occurred in the drafting of the Bill through certain divergences of opinion as to the mode of its application. The measure proposed is, therefore, somewhat of a compromise; but, unlike similar legislation in France and Germany, it does not confer on the State any right to effect the necessary interconnections by the compulsory purchase of existing interests.

The idea now is to weld the activities of existing producers, distributors and consumers into a united co-operative effort that will, under a wise measure of Government control and encouragement, but without undue official interference, enable the essential industries of Belgium to keep pace with foreign competition. Several leading electricity supply companies have already constituted a co-operative society for production and distribution purposes. The most powerful companies are in the combine.

Reviews.

Theory of Machines. By LOUIS TOFT and A. J. KERSEY. Pp. ix+408; 272 diagrams and illustrations. London: Sir Isaac Pitman and Sons, Ltd. Price 12s. 6d. net.

Considering the extent to which the subject "Theory of Machines" appears in the syllabuses of the various higher examinations in engineering science, such as the B.Sc.; A.M.I.C.E., &c., it is rather remarkable how few good text-books there are which may be said to meet the requirements of those studying for these examinations. Here, at last, we have a book which has been expressly written to cover the syllabuses of the Universities on this subject, and, as a knowledge of the fundamental principles of mechanics is generally necessary for a complete understanding of the problems arising in the Theory of Machines papers, these have been included by the authors in their work. The result is, we venture to say, a book which extends in usefulness beyond the rather narrow bounds suggested by the author's title, and which may be regarded more as a treatise on "Mechanics as Applied to Engineering Problems." It is true that the authors have assumed that the reader has a knowledge of mathematics equivalent to that expected of students taking their degree in engineering or the associate-membership examination of one or other of our technical societies, but this may be said to comprise only a very elementary knowledge of trigonometry and of the calculus which in these days of secondary education almost every engineer should possess.

The ground covered by the book includes an investigation into the subject of vectors, which is equally applicable to electrical quantities as to forces or velocities, and this is followed by a study of the various forms of mechanisms with which the "Theory of Machines" is primarily concerned. The practical application of these theories leads to a study of the various forms of mechanical drive, directly-coupled shafts, belts, toothed wheels, &c., as well as to the problems of friction and lubrication. In this connection an interesting investigation is given into the theory of the Michell bearing which constitutes so important a detail of the modern steam turbine. Also of interest to the steam turbine designer is the chapter on governors, in which the theories underlying the design and operation of this vital adjunct to the turbine is considered. An elementary treatment of the theory of the whirling of shafts is also given, and while this may not be sufficiently comprehensive to cover the case of the shaft of a large turbo-alternator, it will certainly serve as an introduction to the more difficult problem. As is to be expected in a work of this nature, the reciprocating-engine mechanism comes in for very lengthy treatment, but in view of the increasing application of the internal combustion engine in its various forms to the driving of electrical generators, these portions of the book are of considerable interest to the electrical engineer. A large number of examples, numerical and otherwise, are given at the conclusion of each chapter, these having in many instances been culled from actual examination papers of the bodies referred to above. Numerical answers to the examples are given at the end of the book, together with a summary of the various formulæ employed in the various chapters. This last should prove of great value to the student on the eve of his examination.

Although written primarily for the student who is preparing for one or other of the higher examinations in technical science, this book should prove of considerable value to the engineer who is desirous of understanding the fundamental mechanical laws governing the operation of engines and machinery in general. The authors are to be congratulated on the clear and concise manner in which they have dealt with what is generally deemed to be an uninteresting subject. The publishers, too, are deserving of every praise for the excellent manner in which the book has been produced, particularly in view of the very moderate price charged for it.

Treatise on Thermodynamics. By Dr. MAX PLANCK, translated with the author's sanction by ALEXANDER OGG. Pp. xiv+297. London: Longmans, Green & Co., Ltd. Price 15s. net.

In the realms of engineering science it is often very difficult to assert whether the theories of pure science have formed the basis of subsequent practical discoveries, or whether theories have been afterwards developed to account for the facts observed in the practical applications of science. Certain it is that very frequently theoretical investigations have led to practical applications of world-wide importance—wireless telegraphy and telephony are classical examples—and in no branch of science is this exemplified to a greater extent than in the science of thermodynamics or—to give it a more popular title—the science of heat engines. It must be admitted, of course, that many of the discoveries which have led to the development of the various types of heat engine which are in practical use at the present time have been made by men who had little or no knowledge of the theories underlying the design and operation of their engines, but the use of superheated steam, the binary vapour engine, to mention only two important lines of progress, have been dictated by purely theoretical considerations.

Thus the work under review may well claim the serious attention of those electrical engineers who are concerned with the design and operation of the prime movers used in the driving of electrical generators. It may perhaps claim to be one of the standard text-books on the subject, as witness the fact that it has already achieved its seventh edition in Germany, the country of its origin, since it was first published in 1897, while the present English edition is the third translation, having been brought up-to-date from the latest German edition. For the benefit of those who are unacquainted with Planck's thermodynamics, it may be mentioned that the author is not concerned with the various theories underlying the production and transmission of heat, but with the fundamentals of the problem of converting heat into mechanical work, and these are deduced from a consideration of the two well-known laws of thermodynamics. After a preliminary section dealing with the various physical laws governing temperature, total heat, work done during expansion under different conditions, a section is devoted to the first law of thermodynamics and its application to (*a*) a perfect gas regarded as a homogeneous system, and (*b*) a non-homogeneous system as exemplified by the steam engine or a refrigerating machine. The treatment of the second law of thermodynamics also commands a special section, the procedure adopted being similar to that for the first law. The second half of the work is devoted to the applications of these laws to the various theoretical problems arising in the consideration of the cycle of operations in a heat engine. The work is frankly theoretical throughout, and might be deemed more suitable to the student of physics than to the student of engineering, but those who are taking the higher university examinations in engineering science or those who are desirous of studying the fundamental laws underlying the operation of heat engines will find a study of this book not only of great value, but also, we think, of considerable interest.

Repair Shop Diagrams and Connecting Tables for Induction Motors. By D. H. BRAYMER and A. C. ROE. Pp. xiii+232; figs. 161. London: McGraw-Hill Publishing Co., Ltd. Price 12s. 6d. net.

These two American writers are already known by books on cognate subjects, written either conjointly or independently. The most useful review of the present work is a statement of its contents and of the type of engineer for whom it is intended. For this purpose we cannot do better than use the authors' own words. "The object of this book is to furnish repair men and armature winders with practical step-by-step instructions on the laying out of coils for induction-motor windings and connecting the ends of the groups of these coils in proper sequence of phase and pole groups for different types of windings used in motors of from 2 to 24 poles, 2- and 3-phase. The information presented can also be used when reconnecting the coil groups to satisfy changes in voltage, changes for operation on circuits of different numbers of phases, different frequencies, or changes in speed of a motor. . . . In order to make a connection job as easily understood as possible, and to provide a uniform basis for the connections of all windings, the single line type of diagram is the one used throughout, supplemented with connecting tables that show for the different types of winding all the practical connections possible. The diagrams and connecting tables have stood the test of a number of years of use by Mr. Roe, and have been developed in such form that the average winder will find them easy to follow and to check. . . . These diagrams are not intended for the use of designers, but as practical shop instructions for winders and for repair men who are called upon to lay out and connect up new windings or reconnect existing windings for voltage and other operating changes."

It only remains to be added that the authors have carried out their intention, and have done it well.

Accident Prevention.

The Industrial Welfare Society has sent us a copy of the programme of a conference which will be held in London on Friday, January 27th, the subject being "Accident Prevention." Very considerable progress has been made during the last four or five years in reducing the incidence of accidents in industry. Particular emphasis is placed on the successful efforts of many firms to reduce the number and minimise the consequences of minor accidents which are not reported in official statistics. These minor accidents have been in the past, and still are, a source of much lost time and efficiency, and it is in this direction that solid, if not spectacular, progress has been made. Lord Invernairn is to preside at the luncheon. The proceedings will include the following papers:—"Accident Prevention—Works Discipline and Co-operation," Mr. James Smith, and "The Competitive Spirit in Accident Prevention," by Mr. Bernard L. Lelliott. Further information will gladly be given by Mr. G. P. Holden, Industrial Welfare Society, 51, Palace Street, London, S.W.1.

Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations and Failures.

The Contractors' Dinner.

The annual dinner of the E.C.A. Allied Associations was held at the Trocadero, W., on January 17th. Mr. W. A. Shaw, president, occupied the chair, and he was supported by a number of leaders in the electrical industry. The company numbered about 260. The speakers were the president, Col. the Rt. Hon. Wilfrid Ashley, M.P., Mr. H. J. Miles (immediate past-president), Sir Harry Haward (Electricity Commission), Mr. Frank Hodges (Central Electricity Board), Mr. F. W. Purse (president, I.M.E.A.), Col. R. K. Morcom, C.B.E. (chairman, B.E.A.M.A.), Mr. H. J. Cash, Mr. J. W. Beauchamp (president, E.T.B.I.), and Mr. W. Cross.

A full report of the proceedings will appear in our next issue.

The British Industries Fair.

On February 24th, the Management Committee of the British Industries Fair, Birmingham, will entertain to luncheon at the Fair the members of the following organisations:—The Institution of Electrical Engineers, the Association of Consulting Engineers (Inc.), the Electrical Contractors' Association (Inc.), the Electrical Contractors' Association of Scotland, the National Federated Electrical Association, the Electrical Wholesalers' Federation, Ltd., the Illuminating Engineering Society, and the Association of Mining Electrical Engineers. On February 25th visits will be paid by the Institution of Electrical Engineers, South Midland Students' Section, the Electrical Power Engineers' Association, the Meter Engineers' Technical Association, and the Association of Supervising Electrical Engineers. The visitors on March 1st will include the Incorporated Municipal Electrical Association, the British Electrical Development Association, the Incorporated Association of Electric Power Companies, the Provincial Electric Supply Association, the Municipal Tramways and Transport Association, and the Tramways and Light Railways Association.

The radio section of the London Fair, which was started in 1926, includes 50 leading manufacturers, and is to be more than twice the size it was last year. Applications for space have had to be refused within the last week. The main feature will be portable sets, which are gaining for Great Britain a place in the Continental market previously held by more elaborate American sets.

AUTOMATIC & ELECTRIC FURNACES, LTD., will again exhibit its products on the stand of the Birmingham Corporation Electric Supply Department at Castle Bromwich. The company will show three "Wild-Barfield" automatic hardening furnaces in actual operation. The standard Wild-Barfield high-speed steel-hardening equipment and annealing, case-hardening and enamelling furnaces, fitted with automatic control for time and temperature will also appear.

Registered Electrical Contractors.

The following applications for registration were accepted by the Executive Committee of the National Register of Electrical Installation Contractors at its last meeting:—

Harwood, T. V., & Co., Morecambe.
Thomas, M. J., Thornbury, London, E.2.
Sweetmore, John, Burnley.
Buxton & Longley, Thornton Heath.
Electromobile Engineering Co. (West Bromwich), Ltd.
Wilson, E. H., Liverpool.
Spencer, R., & Co., Halifax.
Farrar, W. H., Oswestry.

At the same meeting one application was withdrawn and three were declined.

Central American Electrical Trade.

A dual report upon the economic and financial conditions of the Republics of Honduras and El Salvador has been issued by the Department of Overseas Trade (Stationery Office, 1s. 6d. net). The Honduras section is by Mr. A. H. King, British Consul at Tegucigalpa. It shows that during 1925-26 the imports of electrical machinery were valued at $157,430, as compared with $108,623 in 1924-25. Practically the whole of this was supplied by the United States, although, generally, Great Britain is by far the largest exporter to the market.

The report on El Salvador, by Mr. G. Harrington, British Consul at San Salvador, shows that the imports of electrical material rose from $78,165 in 1924 to $210.713 in 1925; at the same time the British share fell from $1,738 to $1,541. The value of electrical machinery and apparatus imported also rose, from $87,588 to $133,507; in this case the British share increased from $268 to $8,352.

Safety First.

The Accident Prevention Department of the National Employers' Mutual General Insurance Association, Ltd., has sent us four further posters in connection with its industrial accident prevention service. These convey warnings regarding very diverse accident risks in a novel and effective manner.

Hired Wiring at Greenock.

The Greenock Corporation Electricity Department (engineer: Mr. D. McDougall) is circulating a little booklet containing particulars of its installation hiring scheme. A feature of this is a list of five local contractors from whom information and advice can be obtained. An illustration of the types of fittings supplied shows that the flat conical shade so often used in connection with such schemes has been abandoned in favour of better-looking and more efficient patterns.

Local Exhibitions.

BIRMINGHAM.—An exhibition by the Birmingham Scientific Society, which was held in conjunction with the annual conversazione of the Birmingham and Midland Institute recently, included a number of exhibits of electrical interest. The General Electric Co., Ltd., demonstrated methods of lamp manufacture. Messrs. Joseph Lucas, Ltd., showed a range of ignition apparatus, dynamos and starters, and demonstrated magneto and dynamo armature winding, and battery and condenser manufacture. Messrs. Kelvin, Bottomley & Baird, Ltd., exhibited ultra-violet ray apparatus, Frigidaire, Ltd., household refrigerators, and Messrs. Parker, Winder & Achurch, Ltd., Birmingham, electrically-driven floor polishing and scrubbing machines. In addition, a new electrically-operated gramophone with an elaborate mechanism controlled by electricity, enabling the automatic playing of a continuous programme of twenty records, was shown by Mr. J. H. Riley, for the Gramophone Co., and the G.E.C. gave demonstrations with the "Gecophone Orchestrola," an instrument equipped with a powerful amplifier and loud-speaker, used in conjunction with a gramophone pick-up device. Mr. J. B. Kramer exhibited magnetic separators, electric drills, blowers, and hand-grinders; Professor Wm. Cramp, of the Department of Electrical Engineering, Birmingham University, demonstrated the flashing neon tube and its hydraulic analogy, and Mr. Arthur J. Potts showed an improved mains type of radio receiver.

LONDON, W.—An electrical display by the GENERAL ELECTRIC CO., LTD., in co-operation with St. Marylebone Borough Council, was prominent in an exposition of various trade products held recently at the Polytechnic, Regent Street, W.1. The electrical display included, in addition to a comprehensive range of the smaller "Magnet" household appliances and fires, a model electrical laundry. Demonstrations were given at intervals with a wash boiler, a "Wizard" for washing and wringing, a grand ironer (incorporating a revolving cylinder), and domestic hand-irons, with an "Eco-dry" cabinet and a drying horse—used with an electric fan—for clothes drying purposes.

WISHAW.—An exhibition of appliances under the auspices of the burgh electricity and gas departments was opened by Provost Archibald recently.

Malayan Electrical Imports.

The *Board of Trade Journal* states that during the first nine months of 1927 the imports of electrical goods and apparatus into British Malaya were valued at £435,341, as compared with £364,127 in the corresponding period of 1926.

The Timber Trade.

Our Timber Trades Correspondent states that business during the past month has been hindered considerably by the inclement weather affecting transport and outdoor work to a large extent, both of which have had a depressing influence on deliveries into consumption, especially building woods. Imports of such woods have declined considerably over the past four or five weeks, and now that navigation in the north of Europe is closed fresh stocks for the next four months will be small. Spot prices are firmer than a month ago, for the weak sellers are fewer, and prices for futures are very firm. Of mahogany, imports are lighter, but for other hard logs and sawn wood imports have increased considerably compared with this time last year. The outlook, however, is promising, as trade generally is advancing in all directions, which will call for additional supplies of wood of one kind or another. Stocks of plywood on the market also are ample at present rates of consumption, with forward buying on the small side.

Unemployment.

There was a serious increase (232,250) in the number of unemployed during the period ended January 2nd. At that date the total was 1,332,300, as compared with 1,100,050 on December 19th, and 1,495,839 on January 3rd, 1927. The rise is attributed to the complete cessation of building operations owing to the recent severe weather, in addition to the normal dismissal of workers after the Christmas trade, and extended short-time working.

The Industrial Co-operation Conference.

On January 12th the first meeting between a group of representative employers and delegates of the General Council of the Trades Union Congress took place at Burlington House, W. The employers' group, headed by Sir Alfred Mond, who was elected to the chair, included Sir Hugo Hirst, Bt., Sir Edward Manville, Sir Charles Parsons, Col. F. Vernon Willey and others. The trade union representatives, who were led by Mr. Ben Turner (chairman of the General Council), numbered several well-known leaders. In his opening address, Sir Alfred Mond said that his friends realised that more was to be gained by co-operation with the unions than by endeavours to destroy them. He emphasised the fact that the employers present were not representatives of their particular industries, and said that he looked upon the trade union delegates in the same way. It was proposed that the conference should survey a number of factors affecting both employers and employés, and among the subjects which might be jointly investigated were housing; unemployment schemes; the effect of national and local taxation upon the development of industry; the cause of trade disputes and their avoidance; participation by the worker in profits of industry; and the setting-up of a permanent standing committee to meet for consultation from time to time on topics affecting industry.

Mr. Ben Turner said that the General Council of the T.U.C. had a real appreciation of the spirit behind the invitation to the conference. The trade union movement had been built up by industries, and it was impossible to make certain that any proposals put forward would be adopted by all industries, as the employers realised at the outset with regard to their own side. He asked what steps the employers would take to secure the greatest possible support for any agreed principles. For the trade unions' part, he said that the General Council exercised a certain moral authority in the movement and could call a congress of affiliated unions to discuss important national questions. The Council could then do a great deal to implement agreements, even though it fell short of possessing direct executive authority. He thought that the very fact of their meeting was giving rise to better industrial relations; patience and tolerance was needed to make the conference a success. Mr. Turner, in conclusion, said that both sides understood that they could not in any way trespass upon the sphere and functions of existing organisations of employers and trade unions.

Sir Alfred Mond said that the future would be concerned with investigation, not negotiation. To facilitate the work the employers had formed a committee consisting of himself, Lord Londonderry, Sir David Milne-Watson, Sir Hugo Hirst, Lord Ashfield, Lord Weir, Col. F. Vernon Willey, and Mr. J. Conway Davies (secretary).

Mr. Turner said that the appointment of a committee would be considered at the next meeting of the General Council of the T.U.C. It was agreed that Mr. Turner should occupy the chair at the next meeting.

The Central Scotland Transmission Line Towers.

It is reported that the first sub-contract in connection with the Scottish scheme—comprising the design and manufacture of the steel transmission line towers—has been given to Messrs. Milliken Bros. and Blaw-Knox, Ltd. Each of the 1,550 towers will be 80 ft. in height, erected on concrete bases. The towers will be square in formation and designed on the "trellis" principle, tapering off to about eight feet at the top. Over the Clyde Valley the towers will vary in size and height, two being carried to a height of 200 ft., while it is stipulated that lines carried over the roofs of houses must be at least 80 ft. in height. The towers will lead from Clyde's Mill, near Rutherglen, into Dalmarnock, and thence to Port Dundas, on the north side of the city, to Yoker. There will be a somewhat similar scheme for the south side, with Govan as an important linking-up centre to Paisley.

Social Events.

On January 6th thirty members of the staff of the Leatherhead and District Electricity Co., Ltd., met for their sixth annual dinner in "Ye Olde Running Horse Hotel," Leatherhead. Mr. G. W. F. Horner, engineer and manager, and Mr. W. E. Owen, assistant engineer and manager, were present. Mr. Horner, in a short speech, dealt with the company's working during the past year and its future intentions. An entertainment was provided by the following members of the staff:—Messrs. E. Chapman, G. W. F. Horner, H. F. Brown, T. H. Birch, J. Steele, D. T. King, C. J. Clark, F. W. Ferrari, and Head.

Mr. Arthur Cozens, electrical contractor, of Ascot, Camberley, Clacton and Henley, again entertained his electrical staff and friends at a New Year's party and dance at the Cordes' Hall, Sunninghill, on January 6th. A large number were present, and a very happy and enjoyable time was spent.

The fifth annual Junior Social, conducted under the auspices of the G.E.C. Social and Athletic Club, took place on January 6th, at Magnet House. Some 180 members of the junior staff attached to the headquarters of the General Electric Co., Ltd., were entertained by the committee of the Club. Dancing, games, community singing, an entertainment by Mr. Gill, and ample refreshments were enjoyed with zest.

The annual concert of the Sports Club of the Brush Electrical Engineering Co., Ltd., was held at the Town Hall, Loughborough, on January 11th. A splendid programme of songs, monologues and sketches was enjoyed by an audience of approximately 1,200, which included the heads of all departments and representatives of the company's branch offices. The organisation was in the hands of a committee, headed by Mr. A. G. Deverill, sales superintendent, as chairman. At the conclusion of the performance Mr. W. Johnstone, managing director, made a short speech, in which he regretted that the chairman of the company, Mr. E. Garcke, was unable to attend.

Recent Contracts.

The whole of the 69 houses in the village of Northop, North Wales, have been wired by Messrs. G. J. SCRAGG & Co., High Street, Holywell, North Wales, with the "Henley" wiring system.

Among the recent orders received by B.E.N. PATENTS, LTD., for the B.E.N.-Myers car washer are one for a 2-gun plant for the Glasgow General 'Bus Co.; one 4-gun plant for Newcastle Corporation Tramways; and one 2-gun plant for the Metropolitan Electric Tramways, Hendon.

Our Foreign Electrical Trade.

The following were the values of imports and exports of electrical goods and machinery during December:—

	Dec., 1927.	Inc. or dec. as compared with Dec., 1926.	12 months, 1927. Inc. or dec.
Imports—	£	£	£
Electrical goods and apparatus	445,225	+ 50,146	− 18,036
Machinery	1,358,923	+229,549	+3,829,628
(Inc. electrical machinery	146,900	+ 1,110	+ 438,698)
Exports—			
Electrical goods and apparatus	983,551	− 39,155	−1,485,020
Machinery	4,185,707	+305,939	+4,256,582
(Inc. electrical machinery	488,248	− 23,443	+ 893,747)
Re-exports—			
Electrical goods and apparatus	16,111	− 5,178	− 31,165
Machinery	129,031	+ 7,648	+ 130,730
(Inc. electrical machinery	14,897	+ 7,199	+ 34,635)

The decline of £1,485,020 in the exports of electrical goods and apparatus during 1927, as compared with 1926, needs explanation. The returns for the first eleven months of the year indicated an increase of £648,595. In the December returns, however, it was found that the total for 1926, originally given as £11,606,599, was shown as £13,365,894. The bulk of the difference was traced to submarine cables. Upon inquiry at the Statistical Office, H.M. Customs and Excise, we were informed that "belated export entries received early in 1927 for submarine cables totalling £1,171,330 are included in the corrected figures."

New Municipal Showrooms and Offices.

Preston Corporation proposes, subject to the approval of the Electricity Commissioners, to purchase for the sum of £14,000 premises in Lune Street, Preston, for use as electricity offices and showrooms.

The Norwegian Electro-Chemical Industries.

Dealing with the situation of the electro-metallurgical and electro-chemical industries of Norway in 1927, Mr. Kloumann, director of one of the companies concerned, states in an Oslo newspaper that these industries, as in the case of others, were affected by the appreciation of the krone and of falling sale prices. On the whole, the tonnage of electrochemical and electro-metallurgical exports was maintained, but the sale prices were reduced, and the total value declined from 139,000,000 kr. in 1926 to 111,000,000 kr. in 1927. Mr. Kloumann states that the accounts of the electrochemical industries will show an unsatisfactory situation for last year; in many cases there will have been a loss, despite the fact that the most essential part of the loss through the appreciation of the krone was provided for in 1926. The values and interests concerned with these works, however, are so large that it is sought to keep the works in operation even in unfavourable times as far as possible, and adopt every possible means for lowering the costs of production. If the works have been able to be kept in even activity during the difficult year of 1927 it has been due to a large extent to the fact that they belong to or are connected with international organisations or partly with international capital, which has proved to be sufficiently strong to bear the strain and also undertake the large outlay which has been associated with the extensions and improvements which have been carried out in the past year, in the hope of a better future.

Calendars, &c.

The MULLARD WIRELESS SERVICE CO., LTD., has sent us another "valve" calendar. This has the portrait of a pretty girl set in a representation of a valve, and a block of daily slips.

"Beaver" wiring devices are advertised on a wall calendar with quarterly sheets, received from the HOTPOINT ELECTRIC APPLIANCE CO., LTD., the British agents for these products.

The 1928 calendar of the LONDON ELECTRICAL CO., 1, Sherborne Lane, E.C.2, bears a drawing of a very modern girl.

A useful indexed telephone number notebook has been received from ORION LAMPS, LTD., Liverpool House, Eldon Street, E.C.2.

We have received from Messrs. W. G. BEAUMONT & SON a copy of their cloth-bound "Practical Year Book and Diary," containing many illustrations of their decorative and painting contracts.

Weekly sheets bearing pictures of the company's works and products comprise the 1928 calendar of the BERGMANN ELEKTRICITATS WERKE A.G.

Trade Announcements.

Owing to increased sales the MAGNUM ELECTRICAL APPLIANCES, of Beckenham, has removed to larger premises at Magnum Works, Limes Road, Croydon. A London office and showroom have been opened at Astor House, Aldwych, W.C., where heating appliances will be in stock and on show.

As from January 1st the activities of the DAMARD LACQUER CO., LTD., and MOULDENSITE, LTD., will be continued under the new title BAKELITE, LTD., at 68, Victoria Street, London, S.W.1. Creditors on the books of either company at December 31st, 1927, will be paid in the usual manner.

An agreement has been entered into between AUTOMATIC AND ELECTRIC FURNACES, LTD., and the Allgemeine Elektricitäts Gesellschaft, Berlin, whereby the latter will manufacture and sell "Wild-Barfield" electric furnaces in Germany, Austria, Hungary, Jugo-Slavia, Bulgaria, Turkey, Greece, Rumania, China, Finland, and Luxemburg. This agreement will not in any way affect existing manufacturing and selling arrangements. In regard to the United States of America and Canada, an agreement has been entered into for the manufacture and sale of Wild-Barfield electric furnaces, which will come into operation early this year. Recent orders for electric furnaces have been received from the following by Automatic and Electric Furnaces, Ltd.:—Vickers, Ltd., General Electric Co., Ltd., Great Western Railway, North-Western Railway (India), London, Midland and Scottish Railway, Iraq Railways (Baghdad), Alfred Herbert, Ltd., Imperial Japanese Government, Peel Conner Telephone Works, S. G. Brown, Ltd., H. W. Caslon & Co., Ltd., and the Gramophone Co., Ltd.

Messrs. FALK, STADELMANN & CO., LTD., are making a special display of their electric lighting fittings and electrical and radio apparatus at the premises of Messrs. Watson, Marsh and Co., 346, High Road, Brondesbury, during January. The company states that its senior representative, Mr. E. J. Stockwell, has been appointed manager of the Illumination and Technical Department, which is available to electrical contractors for advice in all matters relating to lighting.

Messrs. N. CAMERON & CO., machinery agents and factors, have removed from Scottish Provident Buildings, Belfast, to 2 & 4, College Place North.

Messrs. K. MALMBERG, LTD., have established an office at 2, High Street, Sheffield. Telephone: Sheffield 22691.

Messrs. R. F. WHITE & SON, who have carried on their business as advertising agents for over a hundred years at 35, Fleet Street, have now removed to more modern premises at 72, Fleet Street. The firm was founded in 1800 by James White and Gilbert White, one of the partners in the present firm, is his great grandson.

Messrs. THORPE & BOSCO, LTD., electrical engineers, have removed to 38, Broad Street, Golden Square, W.1. Telephone: Gerrard 7632.

VENNER TIME SWITCHES, LTD., states that the recent floods put its telephone service out of action, and up to January 18th the G.P.O. had been unable to restore the connections. The company only had 6 in. of water in one shop which was used as a store, and therefore production was not materially affected.

Messrs. CHARLES CLOUT, electrical and wireless engineers, 1 & 2, Priory Place, Dover, have acquired adjacent premises for the extension of their business.

Messrs. H. HIGHMORE & A. DEER have taken over the electrical branch of the business of Jones & Peers, High Street, Hampton Hill.

New Catalogues and Lists.

Messrs. HOLLINGS & GUEST, LTD., Thimble Mill Lane, Birmingham.—List No. A117, illustrating and describing the company's positive-action rotary pump.

MARCONI'S WIRELESS TELEGRAPH CO., LTD., Marconi House, Strand, W.C.2.—Leaflets No. 1,076, dealing with the company's wireless beacon transmitter; No. 1,078, "Short-wave Transmitter, Type S250"; and No. 1,079, "Short-wave Receivers, Types R.g.16 and 16a." Also two valve sheets describing the "K.H.1" and "K.L.1" types.

THE WALSALL ELECTRICAL CO., LTD., 61, Bridge Street, Walsall.—A well-illustrated catalogue of switchboards and charging apparatus. Priced.

MR. ROGER BURGES, Windsor House, Victoria Street, S.W.1.—An illustrated price list describing "Treph" electric lighting fittings.

Messrs. MAVOR & COULSON, LTD., 47, Broad Street, Mile End, Glasgow.—An illustrated pamphlet describing the company's protected troughed belt conveyors for underground service.

THE RYKNELD MILLS CO., Derby.—A circular letter giving prices of the firm's insulating tapes, with samples.

THE CATTELL ELECTRIC MANUFACTURING CO., LTD., New Wells, Wakefield.—Catalogue No. A.1, containing dimensions, particulars and prices of squirrel-cage and slip-ring motors—single-, two- and three-phase.

THE EDISON SWAN ELECTRIC CO., LTD., 123-5, Queen Victoria Street, E.C.4.—A pamphlet and a blue print illustrating the construction of the new "R. C. Threesome" receiving sets. Also leaflets dealing with the company's "local station eliminator," loud speaker, and accumulator charger for a.c. mains, and a chart containing characteristic curves and particulars of a full range of "Ediswan" valves, with prices.

Messrs. SPERRYN & CO, Moorsom Street, Birmingham.—List No. E77, containing illustrated particulars of electrical accessories, including fuse boxes, wall plugs and sockets, flush switches, tumbler switches, &c. Priced.

TRUE SCREWS, LTD., Clerkenwell Road, E.C.1.—A priced catalogue of screws, nuts, terminals, pins, &c.

PHILIPS LAMPS, LTD., 145, Charing Cross Road, W.C.2.—An illustrated pamphlet advertising the "Savelite" electric lamp. Also Leaflet 204, describing the "Duplo" anti-dazzle automobile lamp.

Messrs. L. ANDREW & Co., 2, Whitworth Street West, Deansgate, Manchester.—A price list of insulating materials, including ebonite, vulcanised fibre, mica, asbestos, bakelite, &c.

Messrs. DREW, CLARK & Co., 19, Ludgate Hill, E.C.4.—Sheet No. H.12, advertising "Diamond" telescopic extension ladders. Illustrated and priced.

Messrs. CROMPTON-PARKINSON, LTD., Chelmsford.—Specification No. 2,070, entitled "Semi- and Full-Automatic Rotary Convertor Sub-Station Equipments." Fully illustrated.

DUGDILL'S PATENTS, Hazel Grove, Stockport.—A card bearing illustrations and prices of numerous electric lighting fittings, together with a list of customers.

BRITISH BROWN-BOVERI, LTD., Trafalgar House, Waterloo Place, S.W.1.—An illustrated leaflet advertising "Brown Boveri" rectifiers for heavy currents and high voltages.

Messrs. LEWENZ & WILKINSON, LTD., 25, Victoria Street, S.W.1.—A pamphlet describing the company's new "Work Meter" for registering the performance of machines by means of a time-space graph.

Bankruptcy Proceedings.

EUGENE DURAND (trading as C. Melin & Co., E. Durand and Co., and H. Collins & Co.), 7, India Street, E.C.—The public examination of this debtor was held on January 13th, before Mr. Registrar Warmington, at the London Bankruptcy Court, the accounts showing total liabilities of £43,793 (unsecured £31,815) and net assets valued at £2,073, after deducting £115 for payment of the preferential claims. In the course of his evidence the debtor stated that on the death of his uncle he succeeded to the latter's business of a glass bottle merchant and agent, carried on at 37, Crutched Friars, E.C., under the style of C. Melin & Co. After 1912 he stopped dealing in glass bottles and thereafter he had chiefly been a merchant in glass bulbs for electric lamps and in machines and raw materials used in the manufacture of these lamps. He had always had a number of profitable agencies in the name of "C. Melin & Co." for Continental firms in glass and electrical goods. From about 1920, for the purposes of dealing with retailers in certain goods, and carrying on other agency business, he had also adopted the trading name of "E. Durand & Co." In 1921 he placed an order with a French firm for the delivery of £12,000 worth of tungsten wire at the rate of £1,000 per month; the vendors only made one delivery and then went into liquidation, and he lost about £6,000. His glass and electrical sundries business had always been fairly successful, but since 1920, owing to losses and to heavy bad debts, his finances had been crippled; since about 1923 he had resorted to moneylenders, and the interest and discounting charges on loans in the aggregate amounted to an enormous sum. The necessity for obtaining immediate cash to meet his obligations had caused him frequently to offer extra discounts to customers, and to dispose of goods below cost price, and during the past three years, through selling under cost and giving extra discounts, he had lost probably £2,000. The debtor attributed his failure and insolvency to lack of capital; to bad debts; to losses through depreciation in value of foreign currency; to heavy interest on borrowed money and on discounting trade and accommodation bills; to the cancellation of the order prohibiting the importation of glass; and to loss by sales under cost price. A further loss of £800 was sustained on an option for American rights of a wireless valve, and one of £250 on a shipment of glass bulbs from Belgium. The evidence was concluded.

F. S. RIPPINGILLE, electrical fittings agent, Winchester House, Victoria Square, Birmingham.—An application for the discharge of this debtor was heard on January 12th, at the Court House, Birmingham. The Official Receiver reported that the order of adjudication was made on a creditor's petition in June, 1923. The statement of affairs showed ranking liabilities of £1,510, but the proofs lodged and the probable claims not admitted amounted to £2,648. The difference was mainly

due to the fact that securities consisting of shares in a company promoted by the debtor, estimated to realise £1,050, were unsaleable. The assets, estimated to produce £1,706, realised only £18. The difference was mainly due to excessive estimates placed upon claims by the debtor for breach of contract. The Official Receiver submitted that the assets were not equal to 10s. in the £, that the debtor had failed to keep proper books, and had contracted debts after he was aware of his position. A friend of the debtor's offered to pay to the Official Receiver the sum of £200 within seven days. His Honour granted the application subject to debtor consenting to judgment for £200.

J. BRADY, electrical engineer, 93, Chertsey Road, Woking.—First meeting January 24th, at 29, Russell Square, W.C.1. Public examination February 7th, at the Guildhall, Guildford.

H. REES, works electrician, 67, Chase Road, Morriston, Swansea.—Receiving order made January 9th, on debtor's own petition.

R. C. ADCOCK, electrician, 40, Vicarage Street, Walsall.—Receiving order made January 11th, on debtor's own petition.

A. J. MCMAHON, electrical contractor, 51, St. Thomas Street, Weymouth, and Melcombe Regis.—First and final dividend of 3s. 11¾d. in the £, payable at the Official Receiver's Office, City Chambers, Catherine Street, Salisbury.

Company Liquidations.

BURNDEPT WIRELESS, LTD.—A petition for the winding up of this company has been presented to the High Court by Mr. E. Ball, managing director of J. Boulton & Co., Ltd., creditors, and will be heard in London on January 23rd.

STEVENAGE ELECTRIC LIGHT & POWER CO., LTD.—Winding up voluntarily. Liquidator, Mr. J. J. Gibbons, Broadway Buildings, Westminster, S.W. A meeting of creditors was held on January 18th.

BUENOS AIRES PORT & CITY TRAMWAYS, LTD.—Winding up voluntarily. Liquidator, Mr. J. Fry, 4, Moorgate, E.C. Meeting of creditors January 20th, at the Liquidator's offices.

SOUTHEND RADIO CO., LTD.—Winding up voluntarily, having sold its assets and goodwill to the Short Wave Communications Development Co., Ltd. Liquidator, Mr. C. L. Duff, Norwich Union Chambers, High Street, Chelmsford.

L. WEEKES, LTD.—A meeting of members is called for February 15th, at 1, George Street West, Luton, to hear an account of the winding up from the Liquidator, Mr. B. T. Crew.

Private Arrangements.

LONDON FAN & MOTOR CO., 81, Charlotte Street, London.—A meeting of creditors was held on January 12th at the offices of Messrs. Thorpe & Pearson, 5, John Street, W.C., when a statement of affairs was presented which disclosed liabilities at £1,475 and net assets of £207, leaving a deficiency of £1,268. Mr. Pearson stated that the business was started in May, 1923, by two brothers, J. A. and G. J. Hartigan. The books of the concern had not been properly written up, but it was estimated that the turnover for the period from May 1st to December 31st, 1923, was £4,000. In the following 12 months it increased to £8,000, and in the next year to £9,000. For the year to December, 1926, there was a turnover of £10,000, which in the following 12 months fell to £8,000. The drawings of the two partners had been high on several occasions, and the present position was due to this and to lack of co-operation. There were three suing creditors, and the Sheriff was now in possession. The meeting was adjourned. The following are creditors:—

	£		£
Bergmann Electrical Co., Ltd.	320	Mansell & Ogan, Ltd. ...	52
Baxter, S.	74	Messenger & Co., Ltd. ...	55
Horn, L.	47	Potter, F. W., & Co. ...	20
Jeffery & Co.	40	Woods, M. W	153
Lang & Squire, Ltd. ...	23	Webster, R. K., & Co. ...	44
		Standard Electric Co. ...	420

Dublin Tramway Employés' Wages.

The employés of the Dublin United Electric Tramways Co., Ltd., have agreed to a reduction of 5s. per week in their wages. The question of a further reduction of 1s. is to be the subject of negotiations. The company originally proposed that the reduction should be 10s. per week.

Book Notices.

"Marconi's International Register of Telegraphic and Trade Addresses for 1927-28," published by the Marconi International Code Co. of London at 27s. 6d. (pp. xvi+1811) contains a representative list of registered cable addresses of the principal firms of the world, a comprehensive summary of the chief codes used by the leading business houses in all countries, and a trade or business directory devoted to the requirements of that part of the business world engaged in international commerce. The Register should be invaluable to firms who are interested in overseas trade.

"Progress Reviews" appear from time to time in the *Journal* of the Institution of Electrical Engineers, and are obtainable from the Secretary in pamphlet form at the price of 1s. per copy. The following reviews appear in the January issue of the *Journal*, just published: "Electricity in Mines," by J. A. B. Horsley; "Co-operative Research in 1927," by E. B. Wedmore; and "Electrical Standardisation, 1927," by P. Good.

"Diesel Engine Design," by H. F. P. Purday. Third edition. Pp. xviii+360; figs. 308. London: Constable & Co., Ltd. Price 21s. net.

"Wireless Principles and Practice," by L. S. Palmer. Pp. xi+504; figs. 307. London: Longmans, Green & Co., Ltd. Price 18s. net.

"Switchgear for Alternating Current," by H. W. Clothier. A. Reyrolle & Co., Ltd., Hebburn-on-Tyne.—This is a reprint of the paper read by Mr. Clothier before Section G at last year's meeting of the British Association. It was abstracted in our issue of September 9th last.

"Traders' Rail Charges Up to Date," by J. W. Parker. Pp. vii+128. London: Sir Isaac Pitman & Sons, Ltd. Price 3s. 6d. net.

"Post Office Electrical Engineers' *Journal*." Vol. XX. Part 4. January, 1928. London: ELECTRICAL REVIEW, Ltd. Price 1s. 6d. net.

Publications of the Technical Section of the Association of Engineering and Shipbuilding Draughtsmen.—"Induction Motor Design." By William Sharp. Price 2s. "Lost Volumes from Cones." By W. R. Thomson, B.Sc. Price 2s.

The Home Office has issued Safety Pamphlet No. 12—"Safety Precautions for Transmission-Machinery in Factories." Part II, "Belt Mounting." H.M. Stationery Office. Price 1s. 2d., post free.

The Report of the Building Research Board for the period ended December 31st, 1926, has been issued. H.M. Stationery Office. Price 2s. net. Postage extra.

"Southampton Docks: Handbook of Rates, Charges and General Information." Pp. xlvi+159. London: Southern Railway Co.—This well-illustrated publication should be of great interest and use to importers and exporters.

"*Journal* of the Institution of Electrical Engineers." Vol. LXVI. January, 1928. London: E. & F. N. Spon, Ltd. Price 10s. 6d.

"Pitman's Radio Year Book, 1928." Pp. x+118; illustrated. London: Sir Isaac Pitman & Sons, Ltd. Price 1s. 6d. net.—This book of reference for all who are interested in broadcast reception is in its sixth year of publication, which fact is an indication of its utility.

"Factory Organization," by C. H. Northcott, O. Sheldon, J. W. Wardropper, and L. Urwick. Pp. xi+252. London: Sir Isaac Pitman & Sons, Ltd. Price 7s. 6d. net.

Fairs and Exhibitions.

The International Chamber of Commerce has issued a list of the fairs and exhibitions which are being held during this year. The list covers all parts of the world, and contains brief particulars of something like 540 expositions, large and small. While a number of radio exhibitions appear in the list, there seems to be only one purely electrical show—that at Leicester in March.

For Sale.

Charing Cross Electricity Supply Co., Ltd., invites offers for one four-cylinder and one three-cylinder Sulzer Diesel engines, direct-coupled to 200-V d.c. dynamos. Southwark Hospital, East Dulwich Grove, S.E., has for disposal a number of X-ray parts. Bedford Electricity Department has for disposal one 1,000-kW mixed pressure turbo-alternator and condensing plant. Doncaster Corporation Electricity Department invites offers for one 670-kW turbo-generator, direct coupled to two 335-kW d.c. generators, with condensing plant and auxiliaries, three Babcock & Wilcox water-tube boilers, with superheaters, stokers, &c. Norwich Corporation Electricity Department has for disposal three Babcock & Wilcox drum marine type boilers, two fitted with B. & W. chain-grate stokers and one for oil burning, and one B. & W. oil burning apparatus with steam pumps, heaters, &c. Newport Corporation Electricity Department has for disposal one 500-kW steam set. Liverpool Corporation Electricity Department has for disposal two 350-h.p. British Thomson-Houston turbos, one second-hand milling machine, and one 10-in. second locomotive by Manning & Wardle. Woking Electric Supply Co., Ltd., invites offers for one 1,000-kW frequency changer, with motor-generator, switchgear, cables, &c. Messrs. Fuller, Horsey, Sons & Cassell will sell by auction on January 31st and following days on the premises the entire contents of the Globe Iron Works of J. Musgrave & Sons, Ltd., Bolton. (See our advertisement pages to-day.)

Prices of Raw Materials.

Reporting on January 14th, Messrs. James Forster & Co. stated that the only feature of the market worth recording was the purchasing of a large quantity of lead, some 4-5,000 tons, for April delivery. But for this order prices would have been lower, as consumptive demand is poor, and would not have been able to absorb the large quantities on offer. The Board of Trade returns for December, 1927, showed imports, 26,147 tons; exports, 2,179 tons, leaving 23,968 tons for home consumption.

Messrs. F. Smith & Co. report, January 17th: Copper (electrolytic) bars, £67, 5s. dec.; ditto ditto sheets, no change; ditto ditto wire rods, £77, 5s. dec.; ditto ditto h.c. wire, 9¾d., 1/16d. dec.

Messrs. James & Shakespeare report, January 17th: Copper bars (best selected), sheet and rod, £92, £2 inc.; English pig lead, no change.

Messrs. Edward Till & Co. report, January 17th: India-rubber, Para fine, 1s. 4¼d., ¼d. dec.

Lighting and Power Notes.

Arbroath.—PURCHASE OF UNDERTAKING.—The Town Council has received a letter from the Electricity Commissioners stating that they have received an application from the Grampian Electricity Supply Co. for sanction to the purchase of the generating station of the Arbroath Electric Light and Power Co. The Commissioners propose to approve the purchase, but ask whether the Town Council has any observations to make. The matter has been referred to a committee.

Ashton-on-Mersey. — PURCHASE OF UNDERTAKING. — The Urban District Council has lodged notice of its intention to exercise its powers to purchase the portion of the Altrincham electricity undertaking in its district.

Barnsley.—LOAN.—The Corporation Electricity Committee is seeking sanction to a loan of £7,344 for mains extensions.

Beckenham. — DOMESTIC SUPPLY PROGRESS. — We have received from Mr. J. E. Tapper, engineer and manager of the Urban District Council electricity undertaking, particulars of the progress made in connection with the domestic supply. Of the 9,000 houses in the area of supply, 5,725 are connected to the mains, or 63.61 per cent. A scheme for hiring apparatus was inaugurated in October, 1925, and the number of appliances now on hire is 401 cookers and 387 kettles, of which 247 and 244 respectively were added during the past 12 months. Under the Council's assisted wiring scheme 1,661 consumers have been connected. Appliances other than those mentioned above are not hired. The value of wiring and sales of apparatus has increased from £3,595 during 1921-22 to £9,962 during 1926-27, and the estimated total for 1927-28 is £13,000. Up to the year ended December 31st last, the actual sales of domestic appliances totalled 1,006.

Blackburn.—CONSULTING ENGINEER'S REPORT.—The Corporation has received from Mr. A. H. Dykes his report on investigations he has made into the electricity undertaking. He states that the technical design of the Whitebirk power station, which was completed in 1921, and the technical management and operation are not at fault, and the gross profit, before providing for interest and loan repayments, is quite satisfactory. The whole trouble is on the financial side, the interest and sinking fund charges being out of proportion to the output of the station. The plant and general lay-out are excellent, the station is worked very efficiently, the staff is not unduly large, and the technical results are good, reflecting credit on the engineering management. The weakness of the present position lies in the administration, and he recommends that there should be appointed to manage the department a committee of five, giving them full executive powers, subject to any financial limits the Council cares to impose. He also recommends, among other things, that sales canvassers should be appointed; that every effort should be made to utilise electricity in the Council's own business; that pending a large increase in power, every endeavour should be made to encourage the growth of the domestic load; that where possible staffs should be reduced; and that economy should be effected wherever possible. In conclusion, Mr. Dykes states that technically there is nothing wrong with the undertaking and that the present position is due to financial causes, consequent upon the manner in which the station was built during abnormal times, and to the expected development being delayed owing to the adverse trade conditions now prevailing in the area.

Brierfield.—CHANGE-OVER.—The Urban District Council is to apply for sanction to borrow £15,320 to change over the present system of electricity supply from d.c. to a.c.

Bristol.—LOANS.—Application is being made by the Corporation Electricity Committee for sanction to borrow £200,000 for mains.

Sanction has been received to a loan of £10,000 for the provision of electric cookers for hire, and the Committee now recommends application for a loan of £2,500 for wiring work in connection with the installation of the cookers.

Canada.—HYDRO-ELECTRIC DEVELOPMENT.—An application has been made by the Montreal and Western Canada Company to the Federal Government for legislative authority to develop the power of the rapids on the St. Lawrence below Cornwall. The company proposes to build a 30-ft. waterway between Cornwall and Montreal. The project involves a deep waterway from Montreal Harbour to Laprairie Basin, a canal from the basin to Caughnawaga, a waterway through Lake St. Louis to Melocheville, another canal from that point to Hungry Bay, and a 30-ft. waterway through Lake St. Francis to Cornwall. The names of the promotors of the scheme are not given.

A *Reuter* message from Ottawa states that the National Advisory Council on the joint Canadian-United States scheme to improve the waterway and develop the power of the St. Lawrence River between Montreal and the Great Lakes has given its report. The Council recommends the Government to adopt the development project in principle with provision for a 27-ft. channel instead of a 30-ft. channel as originally planned, thus reducing considerably the cost of development. A construction period of 12 years is anticipated. The cost of the whole enterprise is put between $300,000,000 and $400,000,000. Canada has been invited by the United States Government to open immediate negotiations for a preliminary convention on the whole project. The Council advises the retention under Canadian control of all the works within Canadian territory, and advises that the scheme is commendable on economic grounds. No specific recommendation is, however, made as to the date of commencement of the work. The Canadian Government is unlikely to ask Parliament to take any definite action in the matter during the coming session. While the United States seems anxious to have a treaty negotiated without further delay, the Canadian Government seems to favour postponing the beginning of the project for at least a year.

Carlisle.—SUPPLY TO HOUSING ESTATES.—The Corporation Electricity Committee has obtained sanction to the borrowing of £3,500 for mains and services in connection with the supply of electricity to the Botcherby and Raffles housing estates.

Continental.—ITALY.—According to the recent statistics published by the various electrical societies in Italy, the output of electrical energy for the first ten months of 1927 was 5,200,000,000 kWh, an increase of 200,000,000 kWh, as compared with the preceding year.

LUXEMBURG.—Eight of the electricity distribution undertakings in Luxemburg are being brought under one control by the recent formation of the Société de Transports d'Energie Electrique du Grand Duché, on a co-operative basis, with a minimum capital of 500,000 fr.

FRANCE.—The Government's Budget for 1928 includes a sum of 100 million fr. for the development of rural electrification in France.

Crowle (near Doncaster). — ELECTRICITY SUPPLY.—The Urban District Council has agreed to meet representatives of the Yorkshire Electric Power Co., Ltd., with a view to obtaining a supply of electricity for the district.

Douglas (I. of M.).—QUAY LIGHTING.—The Harbour Commissioners have decided to convert the whole of the lighting of the north and south quays and the Battery piers from gas to electricity.

Dundee.—CABLES OVER THE TAY.—The report of the sub-committee of the Dundee Harbour Trust regarding the scheme of the Central Electricity Board to carry h.p. cables over the Tay is unfavourable to the proposal. A letter to this effect has been sent to the Board. It is considered that the necessary piers would be a danger to navigation.

Durham.—ELECTRICITY SUPPLY.—The Rural District Council has instructed the surveyor to prepare a scheme with one power station situated near Shincliffe, which would be capable of supplying electricity to the whole of the Council's area, and an alternative scheme for separate power stations situated in convenient grouping centres. The clerk is also to prepare an estimate of the cost of obtaining powers to supply electricity in the rural area.

East Ham.—LOAN.—The Corporation Electricity Committee is to apply for sanction to a loan of £4,500 for mains.

Edinburgh.—PIER SCHEME.—The Corporation has approved a recommendation that a combined scheme for a pier at Portobello, with sea-water culverts for the generating station be proceeded with at an estimated cost of £90,000.

Gravesend.—CHANGE-OVER.—The Corporation Electricity Committee is to change over two districts from d.c. to a.c. at a cost of £1,575.

Harrogate.—LOAN.—The Town Council is to apply for sanction to a loan of £151,192 in connection with the supply of electricity to outside areas, including Ripon. The loan includes £61,000 for a 6,000-kW generating and boiler-house plant, including the conversion of the present single-phase plant to 3-phase, and £57,892 for an e.h.p. ring main system, with sub-stations, switchgear, and transformers.

Harwich.—LOAN.—The Corporation Electricity Committee is applying for sanction to the following loans: £1,450 for mains extensions in Dovercourt; £500 for meters; and £1,000 for assisted wiring.

Keighley.—NEW ELECTRICITY CHARGE.—The Electricity Committee has recommended the Town Council to approve an offer of electricity to consumers at a flat rate of 0.5d. per kWh for all electricity consumed between midnight and 6 a.m., where such consumers are taking a supply of electricity during the whole of the daily working hours of their particular trade or business.

NEW PLANT.—The Committee has reported to the Council that the demand is growing to such an extent that it has become imperative that the supply of electricity should be augmented, and has recommended that application be made for sanction to the provision of additional plant.

Lincolnshire.—ELECTRICITY SUPPLY.—Three companies are seeking powers to supply electricity in urban and rural areas of Lincolnshire. The Lindsay Council which exercises administrative control over the northern area, has communicated with the various local bodies, suggesting that they should defer pledging themselves to supporting any particular scheme until further details have been rendered available, and these, it is anticipated, may be forthcoming at the joint conference of the various district councils concerned, which it is intended to convene at an early date. The selection of one of the

county schemes appears to be favoured by the Gainsborough, Brigg and other councils, but the Isle of Axholme authority, although not yet committing itself to any definite decision, appears to favour the acceptance of the offer of the Yorkshire Electric Power Co., which is seeking to supply a section of the northern part of the county. The Louth authority has taken independent action, by entering into an arrangement to obtain a supply from the Grimsby Corporation, and the Bourne Council in the south of the county appears to favour taking electricity from Peterborough, as the Spalding Council has already done. It is regarded as probable that at Scunthorpe the authorities, who are now taking a supply from a private firm, will arrange to set up their own supply, in which case it is probable that they will be required to extend operations to some of the surrounding districts.

Mansfield.—LOAN.—The Town Council has applied for sanction to a loan of £10,000 for meters.

Plymouth.—LOAN SANCTIONED.—The Corporation Electricity Committee has obtained sanction to the borrowing of £100,000 for distributing mains and services.

Preston.—ELECTRICITY EXTENSIONS.—The Town Council will consider on January 26th a scheme to apply for powers to supply an area north of the River Ribble. The first step was the supply of electricity to Blackpool during the autumn illuminations. The new scheme includes a supply to the urban district of Kirkham, Fylde rural district, and part of Garstang rural district.

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

EAST HAM.—Lighting: Flat rate, 6d. per kWh for the first 250 kWh per quarter, and 4½d. per kWh for all electricity in excess of this amount; sign and outside shop lighting, 4½d. per kWh; maximum demand rate, 8d. and 3d. per kWh. Power: First 250 kWh per quarter, 3d. per kWh, next 2,750 kWh, 2½d., next 7,000 kWh, 2d., over 10,000 kWh, 1½d.

DEWSBURY.—Lighting: From 5d. to 4½d. per kWh. Power: Maximum demand rate from 3½d. and ½d. per kWh to 3d. and ½d. Special charges for restricted hours: Varying from 1.2d. per kWh for 5,000 kWh per quarter to 0.8d. for over 25,000 kWh. Lighting and heating based on ratable value: From 1.31d. to 1.2d. per kWh. Prepayment meters: From 6d. to 5½d. per kWh.

South Shields.—LOANS SANCTIONED.—The Corporation Electricity Committee has received sanction to the borrowing of £10,000 for wiring installations.

Special Orders.—The Electricity Commissioners have submitted to the Minister of Transport for confirmation Special Orders made by them authorising the Derbyshire and Nottinghamshire Electric Power Co. to supply in the urban district of Warsop, the rural districts of Leake Newark and Southwell, and parts of the rural districts of Basford, Bingham, Skegby and Stapleford, and the Electrical Distribution of Yorkshire, Ltd., to supply in part of the township of Austhorpe.

Stretford.—LOAN SANCTIONED.—The Urban District Council Electricity Committee has obtained sanction to loans of £8,422 for a main transmission line, and £20,000 for mains and services.

Torquay.—LOANS.—The Town Council has applied for sanction to loans of £12,500 for mains and services, and £500 for erecting and equipping small sub-stations.

Tunbridge Wells.—LOAN SANCTIONED.—The Town Council has received sanction to a loan of £6,839 for electricity purposes.

OPPOSITION TO BILL.—The Council has decided to lodge a petition against a Bill promoted by the Weald Electricity Supply Co., Ltd., to purchase the undertaking of the Crowborough District Gas & Electricity Co., and to extend its area of supply.

Wakefield.—LOAN SANCTIONED.—The Corporation Electricity Committee has received sanction to a loan of £5,000 for meters.

Tramway and Railway Notes.

Bradford.—RAILLESS CARS.—The Corporation tramways Committee has authorised the general manager to link up the railless-car services between Clayton and Oakenshaw so as to provide a through service over the two sections.

Continental.—ITALY.—A recent return shows that up to the end of May last 702 miles of railways in Italy had been electrified, an increase of nearly 90 miles in twelve months.

SPAIN.—Work has commenced on the construction of an electric tramway between Guadix (Granada) and Alindia (Valencia province).

La Sociedad Energia Electrica de Cataluna has secured the contract for the supply of power to about 28 miles of the electrified portion of the Northern of Spain Railway. In connection with the work, it has just commenced the establishment of a 110,000-V transmission line between Manresa and Vich. At the reception station transformer plant is to be installed to step down the current to 22,000 V, and thence to 3,000 V.

AUSTRIA.—It is reported from Vienna that four large electrical manufacturing firms announce a new step with a view to induce the Federal Railways or the Government to proceed with the electrification of the main line between Vienna and Salzburg. They have made a calculation of the expenses of construction and equipment amounting to 150 million sch., whereas the Federal railways estimate the outlay at 200 million sch., and they believe that the conversion would be remunerative, this comparing with a deficit estimated by the railways at the present price of coal. The firms are ready to submit an offer undertaking to construct the line at their estimated cost and be satisfied for the service of the interest on the capital with the annual economy resulting from the conversion.

Glasgow.—EXTENSIONS TO PINKSTON STATION.—The Corporation recently considered a recommendation of the Tramways Committee that the proposals of the manager for the installation of new plant at an estimated cost of £237,500 be approved, and that the manager be instructed to take offers for (1) a new 18,750-kW turbo-alternator; (2) six new 50,000-lb. boilers to replace the present boilers in Pinkston power station; (3) h.p. switchgear and necessary alteration to buildings; and (4) additional rotary convertors in sub-stations. Discussion followed a suggestion that it should be known how the proposals would affect the Electricity Committee, and eventually it was agreed that a statement dealing with that question should be prepared. Consideration of the proposals to install the new plant was postponed for a fortnight.

Halifax.—SCHEME POSTPONED.—At a recent meeting of the Town Council, the chairman of the Finance Committee moved an amendment to a Tramways Committee proposal for tramway track alterations, to cost £2,000, during the widening of Rochdale Road, and for track alterations in King Cross Lane to cost £9,600. He urged that nothing be done to the tramway track unless under pressure, suggesting that it was inadvisable to insur more capital expenditure on the tramway track. The amendment was carried.

London.—BREAKDOWN.—A breakdown occurred on the L. & M.S. suburban electrified railway on December 11th. At 8.15 p.m. the services from Euston to Watford and from Broad Street to Richmond were affected by a short-circuit on the conductor rails, and the electrical apparatus on a number of trains was put out of action. A statement issued by the company said that the cause was the displacement of a positive conductor-rail. A normal service was restarted shortly after 10 p.m.

UNDERGROUND STATION RECONSTRUCTION.—Good progress is being made with the reconstruction of the three underground stations at Charing Cross, and already it has been found possible to open to the public two additional escalators and various new and more convenient passageways. The new station will be wholly completed in about nine months' time. The existing booking hall will be demolished and a new one constructed with an area three times the size of the present one. The hole-in-the-wall booking hatches will be replaced by a passimeter system, and a waiting and tea room, and a cloak room also will be provided. Originally there were four escalators only, connecting the Bakerloo and Hampstead tubes with the intermediate circulating area. The two new escalators which have already been put into service serve the Hampstead tube. The remaining two will connect the intermediate landing with the street level. It is anticipated that the new station will be able to handle 50,000,000 passengers a year, as compared with 35,000,000 at present.

Sunderland.—SUSPENSION OF SERVICE.—The Town Council has adopted a recommendation of the Tramways Committee to suspend the present tramway service on the Docks route and to replace it by an experimental motor-'bus circular service to the Docks and the East End. An arrangement will be entered into with the Northern General Transport Co., Ltd., to run the 'buses on behalf of and under the control of the Corporation.

Telegraph and Telephone Notes.

Cuba.—RADIO-TELEGRAPHY.—A company has lately been formed in Havana, with the title La Compania Cubana Radio Telegrafica, to organise a wireless-telegraph service between Cuba and Spain.

Cyprus.—NEW TELEGRAPH CABLE.—The cable-laying ship *Colonia* was anchored at Haifa on January 11th in connection with the laying of cables between Port Said, Haifa and Cyprus on behalf of the Eastern Telegraph Company.—*Reuter* (Jerusalem).

Egypt.—RADIO-TELEGRAPHY.—Further extensions of Marconi wireless telegraph services are announced. A high-speed duplex service was inaugurated directly between London and

Constantinople on January 1st, and from January 15th the Egyptian service hitherto operated by the British Post Office will be operated by the Marconi Company in London and by the Marconi Radio Telegraph Company of Egypt in Cairo. The Abu Zabal station has been acquired by the latter company, and will in future be used only as a transmitting station, while a new receiving station has been constructed at Meadi, a few miles to the south of Cairo, in order to provide a high-speed duplex service in place of the present simplex service. Both the transmitting and receiving stations are connected by special landlines to a new central telegraph office in the city of Cairo, where all operating processes will be carried out. The transmitting equipment at Abu Zabal now comprises long-wave and short-wave transmitters and two additional transmitters for use with "beam" aerials which are in course of erection. At the English end the Marconi Company is providing two additional "beam" transmitters at the Dorchester station specially for the London-Cairo service.

Empire Communication. — CO-OPERATION. — Sir William Plender, on behalf of the Eastern and Associated Telegraph Companies, and Sir Gilbert Garnsey, on behalf of Marconi's Wireless Telegraph Company, have been asked to co-operate with a view to making a joint report for submission to their respective Boards as to a possible arrangement in the joint interests of the respective companies.

GOVERNMENT CONFERENCE.—The Empire Conference which the Postmaster-General announced in the House of Commons on December 19th had been called by Great Britain began on January 16th, and, according to *The Times*, was attended by the following:—

Great Britain.—Sir John Gilmour, M.P., Secretary of State for Scotland (chairman) and Mr. Arthur Michael Samuel, M.P., Financial Secretary to the Treasury.

Canada.—Sir Campbell Stuart, Canadian representative on the Pacific Cable Board, with Mr. L. J. Gadoury, Deputy Postmaster-General for Canada, and Commander Edwards, Director of Canadian Radio Services, as his advisers.

Australia.—Mr. Clive Baillieu, with Mr. H. P. Brown, Secretary to the Postmaster-General of Australia, as his adviser.

New Zealand.—Sir James Parr, High Commissioner, with Mr. Milward as his adviser.

South Africa.—Mr. H. J. Lenton.

India.—Mr. P. J. Edmonds, director of wireless in India.

Crown Colonies.—Sir Samuel Wilson, Permanent Under-Secretary of State for the Colonies.

The Telephone Service.—NEW AUTOMATIC EXCHANGES.—The recent introduction of automatic telephony to the Potteries, a populous industrial district embracing five principal towns, *viz.*, Hanley, Burslem, Stoke, Longton, and Newcastle, together with the smaller suburban districts, affects a total population of approximately 250,000. Closely related commercially, the district is an unique example of a network of interconnected exchanges with a common numbering scheme; ten exchanges were originally planned, the five larger being located in the towns above-mentioned, and two smaller ones in Trentham and Chesterton, which form outlying groups situated near Stoke and Newcastle, respectively. The three other exchanges at Endon (near Hanley), Silverdale (near Newcastle), and Kidsgrove (near Burslem), respectively, are to be converted in the near future. The complete equipment for the contract was manufactured and installed by the General Electric Co. (Peel-Conner) telephone works, the number of subscribers' lines already provided for in the area being 5,700, but this number will be increased ultimately to 10,000. Hanley is the main exchange, the others serving as satellites, all inter-exchange traffic passing through Hanley necessarily using two junction lines, one to Hanley and one from Hanley to the required exchange; traffic local to the satellite exchanges is dealt with by discriminating selectors. The percentage of local traffic at Trentham and Chesterton being small, it does not warrant the expense of fitting discriminating selectors; hence a local call at Trentham is passed by a type of connection which is the most complicated to be met with anywhere outside London; it is actually passed over three junction lines of an approximate distance of 10 miles and through five selector switches and three repeaters. A manual board of 19 positions in the Hanley building handles all calls requiring the attention of an operator, and deals with heavy traffic from other towns by means of keysender equipment.

Radio Notes.

Holland.—PCJJ RE-OPENS.—Messrs. Philips Lamps, Ltd., announce that their short-wave station (PCJJ), recently rebuilt, is now transmitting every Tuesday and Thursday, 18-21 hours, G.m.t., on a wavelength of 30.2 metres, as before.

Italy.—ROYAL DECREE.—A Royal Decree, published on December 13th, 1927, creates a new situation and reflects the decisions of the Commission for the Control and Development of the Broadcasting Service which was appointed in January, 1927. According to *World-Radio*, the Unione Radiofonica Italiana, which has carried on the service since its beginning in 1924, has been converted into the "Ente Italiano per le Audizioni Radiofoniche" (E.I.A.R.), to whom the service has been exclusively entrusted, for the period of twenty-five years beginning with December 15th, 1927. The Unione Radiofonica Italiana (U.R.I.) undertakes to transform its organisation and to increase its present capital from lire 6,200,000 to lire 8,200,000. The new shares are being offered to the present shareholders and the wireless industry, to the wireless and electrical trades, to the Society of Authors, theatre proprietors, the Press, musical editors, and to radio listeners. Until December 15th, 1928, the capital of the company will have to be increased to lire 10,000,000. With a view to ensuring the Italian nationality of the new body, the shares are nominal, and they will be negotiable in Italy only. The ordinary revenue of the company will consist of the subscription fees and 90 per cent. of the taxes on sets and materials, the remaining 10 per cent. being for the benefit of the State. The Superior Committee of Supervision will be attached to the Ministry of Communication (Director-General of Posts and Telegraphs); its duty is the provision of such amendments and the study of such steps as will be necessary for the improvement and further development of the service; it will consist of sixteen members (including the chairman), drawn from the trade, industrial, intellectual and juridical circles, and will be all appointed by the Prime Minister. Special committees of supervision will be established in the Italian Mediterranean possessions, to which the decree is extended. Contrary to expectations, taxes on certain materials have not been abolished, but only partly modified, and new ones have been created. The tax of lire 6 on each valve (whether new or regenerated) remains, as does the tax of lire 12 on each crystal set, and lire 24 on each loud-speaker (even when built in the set); the tax of lire 36 on each valve set (not including the tax on the valves) has been abolished and instead of it an *ad valorem* tax of 2 per cent. on each valve set has been imposed, with a minimum of lire 30 (not including the tax on the valves). New taxes concern: headphones, lire 3 (single), lire 6 (double); variable condensers, lire 6; h.f. or l.f. transformers, lire 6; and multiple valves, lire 6; as many times as valves are contained in the multiple valve. For the purpose of controlling the payment of taxes by the public, radio dealers are compelled to keep inventory books, in which entries have to be made of the materials acquired and sold. The annual subscription fee to the broadcasting service has been reduced from lire 96 net to lire 72 net (with possibility of payment in monthly instalments). Schools, educational bodies, &c., are exempt from the obligation of subscription, as are military hospitals and military homes. The above-named subscription is, however, for particular persons only, and compulsory subscription will be applied to administrations of towns, with a minimum population of 1,000 inhabitants (lire 50 a year), there being fourteen categories between the minimum and the maximum. Another class taxed with the compulsory subscription comprises the hotels, thermal and hydrotherapic establishments, watering places, picture houses, kursaals, educational, cultural or sporting clubs, and associations, the fees varying from a maximum of lire 1,500 per annum (*de luxe* hotels), and the group is divided into sixteen categories. The scheme foresees the substitution for the existing Rome station (3 kW) of a new 25-kW station; a new 7-kW station at Milan (actually working); a 1.5-kW station at Genoa (the old Milan station), a 5-kW station at Turin, a 3-kW station at Palermo (the present Rome station), and a 7-kW station at Trieste. The Genoa and Turin stations will be put in operation in 1928, the new Rome station in 1929 and the Trieste and Palermo stations in 1930.

Norway.—LICENCES.—The Broadcasting Co. announces the "paying" number of listeners to have been 61,848 in December, 1927.

Sweden.—RADIO SERVICE.—Swedish broadcasting in 1927 yielded a net profit of about 600,000 Swedish kronor, against 400,000 kronor in the previous year, and there are not less than 53.6 radio sets per thousand inhabitants, according to an official report from the Royal Telegraph Administration, which claims that next comes England with 53, and the figures for other European countries are: Denmark 44.8, Austria 43, Germany 28.1, Norway 22.1, Switzerland 15.9, Czecho-Slovakia 15.2, Hungary 9, Finland 8.8, and Belgium 4.6. After deducting 6 per cent. interest on the capital invested by the Government in the broadcasting business, the net profit of the year means an increase of 150 per cent. since 1925.

Telephone Development Association.—ANNUAL MEETING.—At the third annual general meeting of the Association, held in London, Sir Alex. Roger, chairman, pointed out that the Association had expended 80 per cent. of its total revenue (£15,069) in carrying out its main purpose, namely, stimulating the public demand for telephone service; a balance of £203, subject to income tax, was carried forward. Membership had increased by 45 per cent. to 138. The report and accounts were adopted, and the retiring members of Council, chairman, and auditors were re-elected.

United States.—TELEVISION.—The first demonstration of broadcast radio television arranged by the Radio Corporation of America is reported to have been successfully carried out on January 13th before groups of engineers, scientists, and newspapermen, who, standing before home television sets, saw moving images and heard voices of a man and woman transmitted from the General Electric Co.'s laboratories several miles distant. The pictures were so lifelike that smoke from a cigarette was transmitted as perfectly as on the screen. The receiving sets were installed in three different homes, and all functioned equally well. Transmission was on a 37.8-metre wave-length, while the voice was simultaneously transmitted on 379.5 metres.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Argentina.—BUENOS AIRES.—March 15th. Ministry of Public Works. 24 cranes (steam, Diesel, and electric).* (A.X. 5741.)*

Australia.—SYDNEY.—February 29th. New South Wales Government Railways. One 15-ton, 3-motor electric overhead travelling crane, span 85 feet, for the Chullora electric car repair shops. Chief mechanical engineer, Wilson Street, Redfern, Sydney.

MELBOURNE.—February 22nd. Victorian Railways. Electric butt-welding machine. (B.X. 4095.)*

February 15th. Drum sander, three-drum type, with electric motor and accessories. (A.X. 5722.)*

March 7th. City Council. D.c. switchgear and accessories. (B.X. 4100.)* 6,600-V switchgear. (B.X. 4101.)* Two 2,500-kW motor convertors and accessories, or, alternatively, two 2,500-kW rotary convertors with transformers, &c. (B.X. 4104.)*

February 21st. Postmaster-General's Department. Bells and buzzers. (B.X. 4084.)*

February 28th. Condensers. (B.X. 4089.)* Test desks for auto exchanges. (B.X. 4090.)*

March 13th. Motor generators. (B.X. 4136.)

March 20th. Telephone receivers and parts. (B.X. 4135.)

Barnes.—February 14th. Electricity Department. Rotary or motor convertors with h. and l.p. switchgear. (January 13th.)

Bristol.—January 30th. Port of Bristol Authority. Sixteen 2-ton electric capstans for the Royal Edward Dock, Avonmouth. Specification from the General Manager and Secretary, Docks Office, 19, Queen Square, Bristol.

Dartford.—January 23rd.—Urban District Council. Electric lighting installation (48 houses), Lowfield Street. Surveyor.

Dinnington (near Rotherham).—January 23rd. Electric lighting installation at the Mining and Technical Institute. Specifications from Education Department, County Hall, Wakefield.

Douglas (I. of M.).—The Council is inviting quotations for one 1,000-kW turbo-alternator and accessories.

Edinburgh.—February 27th. Electricity Supply Department. Four steam-generating units complete with mechanical stokers, economisers, air heaters, grit arrestors, chimneys, &c.; steam, water and dust extraction pipework and valves; one electrically-driven and two steam-driven boiler feed pumps. (See this issue.)

Egypt.—CAIRO.—January 31st. Egyptian State Railways, Telegraphs and Telephones, Chief Inspecting Engineer, Queen Anne's Chambers, Broadway, Westminster, S.W.1. Supply of 1,750 vacuum metallic-filament lamps and 3,560 gasfilled lamps.

Greetland (near Halifax).—February 10th. Electric lighting installation at the Council school. Specification from Mr. P. H. Swire, Education Offices, Huddersfield Road, Elland.

Horsham.—February 4th. Electricity Department. One vertical Diesel oil engine (air injection type), direct coupled to a 625-kVA alternator, and one 500-kW rotary convertor, with switchgear, pumps, and auxiliaries. (See this issue.)

Kirkcaldy.—February 1st. Electricity Department. Substitution of a.c. for d.c. plant, and wiring. (January 13th.)

Leyton.—January 28th. Electricity Department. Two 1,000-kW motor-convertors. (January 13th.)

Liverpool.—January 26th. Electric Supply Department. Twelve months' supply of materials, including cables, meters, lamps, troughing, insulators, &c. (January 6th.)

London.—METROPOLITAN ASYLUMS BOARD.—January 25th. Rewiring of the fire-alarm system at the Eastern Hospital, Homerton, E., and installation of electric bells at Chelsea casual ward, &c. (January 13th.)

LONDON COUNTY COUNCIL.—January 30th. 3,700 tons of standard track rails, bolts and nuts, 800 tons of conductor rails. Chief Engineer, Old County Hall, Spring Gardens, S.W.1.

CENTRAL ELECTRICITY BOARD.—March 6th. 132-kV switchgear for outdoor transforming stations. (See this issue.)

Lymm.—January 23rd. Urban District Council. Vertical electrically-driven centrifugal pump. Particulars from Mr. N. Holt, clerk to the Council, Council Offices.

Manchester.—January 25th. Electricity Committee. L.p. steam, water, and air valves for auxiliary services. (January 13th.)

New Zealand.—WELLINGTON.—Public Works Department. January 24th. Induction voltage regulators for Waikaremoana. (B.X. 4116.)*

March 27th. 11,000-V metal-clad switchgear for the Lake Coleridge scheme. (B.X. 4119.)*

March 21st. Post and Telegraph Department. Automatic telephone receivers. (B.X. 4143.)

DUNEDIN.—February 29th. Electric Light and Power Department. 3,000-kW hydraulic turbine, generator and switchgear. (B.X. 4120.)*

Nottingham.—February 4th. Electricity Department. Exhaust, water and other pipework, valves, tanks, &c. (January 13th.)

Oldham. — February 18th. Electricity Department. Steam, feed, exhaust, drain and condenser water pipes, boiler-feed pumps, feed and drain tanks, &c. (See this issue.)

Rothwell.—Electric lighting installation at Stourton Council school and head teacher's house. Specification from Mr. P. Beaumont, West Riding Education Offices, 8, St. John's North, Wakefield.

South Africa.—CAPE TOWN.—February 16th. Electricity Department. 11,000-V and 600-V cables. (B.X.4146.)*

Southall.—January 24th. Southall-Norwood U.D.C. Electric wiring installation at the Sanatorium, Mount Pleasant. (January 13th.)

Stafford.—February 1st. Education Committee. Remodelling of the electric light and power installation at the County Technical College, Wednesbury, and installation of electric lighting and power in the College extension. (January 13th.)

Swindon.—January 28th. Electricity Department. Two electrically-operated overhead travelling cranes. (January 13th.)

February 11th. Electricity Department. Telpher coal conveying plant, &c. (See this issue.)

Waterford.—February 18th. Electricity Supply Department. Three 120-kVA transformers, five 60-kVA ditto. (See this issue.)

York.—February 8th. Electricity Department. H. and l.p. paper-insulated cables. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Aberdeen.—Town Council.

Electrical fittings, for the Streets and Roads Department, for the current year.—William Wilson & Co.

Australia.—SYDNEY.—The tender of the Clyde Engineering Works, of Sydney, has been accepted for the construction of 100 steel railway carriages for the new electrical system, the carriages to cost £5,400 each. Tenders for a further 100 carriages are now being considered.—*Reuter* (Sydney).

CLARENCE RIVER, N.S.W.—County Council. Accepted:—

1,320-h.p. water turbine (£3,407).—Coates & Co. (Boving and Co.).

1,000-kVA 6,600-V alternator (£1,620).—Coates & Co. (Metropolitan-Vickers Electrical Co., Ltd.).

MELBOURNE.—State Electricity Commission of Victoria.

One 55-ton electric travelling crane (£3,574).—John Waygood, Ltd.

Commonwealth P.M.G.'s Department.

Telephones and dials (£2,033).—Ericsson Telephone Co., Ltd.

Underground cable (£82,620).—British Insulated Cables, Ltd.

Underground and aerial cable (£35,404).—Connolly's (through High Commissioner).

Automatic telephone switching equipment (£151,012).—Automatic Telephones, Ltd.; (£40,421), British Electric Co., Ltd. —*Tenders.*

Bexley.—Urban Council. Accepted:—

Installation of an electric fire-call system (£800).—Moore and Knight.

Birkenhead.—Electricity Committee. Accepted:—

One 200-kVA indoor-type transformer (£168), one 150-kVA outdoor-type transformer (£154).—Bruce Peebles and Co., Ltd.

Dumfries.—The Town Council has appointed Messrs. Gordon & Moodycliffe as electricians for town's jobbing work for the ensuing year.

East Ham.—Electricity Committee. Recommended:—
1,000-kW motor-convertor (£3,774).—English Electric Co., Ltd.
Switchgear (£139).—A. Reyrolle & Co., Ltd.
Tramways Committee. Recommended: —
Four-gun car-washing plant (£160).—B.E.N. Patents, Ltd.

Grimsby.—Electricity Committee. Accepted:—
Portable conveyor (£200).—C. H. Johnson & Son.
Four transformers and kiosks (£1,779).—W. Lucy & Co., Ltd.

Tramways Committee. Accepted:—
Alterations and additions to the switchboard, West Marsh sub-station (£225).—Metropolitan-Vickers Electrical Co., Ltd.

Hastings.—Electricity Committee. Recommended:—
6,250-kW turbo-alternator (£24,250).—Brush Electrical Engineering Co., Ltd.
Water-tube boiler, 30,000 lb. steam per hour (£16,427).—Stirling Boiler Co., Ltd.

Horsham.—Board of Guardians. Accepted:—
Wireless installation at the Institution (£177).—Mr. Keith.

Rotherham.—Electricity Committee. Recommended:—
Cable (£801).—Callender's Cable & Construction Co., Ltd.
Switchgear (£87).—General Electric Co., Ltd.
Kiosk and switchgear for Thorpe extension (£132).—Crompton-Parkinson, Ltd.

South Shields.—Highways Committee. Accepted:—
Battery for electric vehicle (£246).—D.P. Battery Co., Ltd.

Forthcoming Events.

Institution of Mechanical Engineers.—Friday, January 20th. Storey's Gate, S.W. 6 p.m. Fifth Report of the Steam-Nozzles Research Committee.
Friday, January 27th. 7 p.m. "Applications of Electro-Chemical Deposits of Metals to Engineering Purposes." Mr. C. H. Faris.

Royal Society of Arts.—Friday, January 20th. John Street, Adelphi, W.C.2. 4.30 p.m. "The Indo-European Telegraph Department." Mr. M. G. Simpson.

Royal Institution of Great Britain.—Friday, January 20th. 9 p.m. "Photo-electricity." Sir Wm. Bragg, F.R.S.
Tuesday, January 24th.—5.15 p.m. "Dielectrics for Electrical Condensers." Mr. P. R. Coursey.
Thursday, January 26th.—5.15 p.m. "Unsaturation of Carbon Compounds." Prof. J. F. Thorpe, F.R.S.

Junior Institution of Engineers.—Friday, January 20th. 39, Victoria Street, S.W. 7.30 p.m. "Steam Accumulators." Mr. S. Hopkins.
Friday, January 27th.—7.30 p.m. "Powdered Fuel for Boiler Firing." Mr. R. H. Allen.

British Electrical Development Association.—Friday, January 20th. Royal Society of Arts, John Street, W.C.2. 7.30 p.m. "Industrial Electric Heating: Sales Possibilities." Mr. J. H. Crossley.

Birmingham Electric Club.—Friday, January 20th. Grand Hotel. 7 p.m. Presidential address. Mr. T. H. Varcoe.

Salford Technical and Engineering Association.—Saturday, January 21st. Royal Technical College. 7 p.m. Presidential address, Mr. J. Morris, and musical social evening.

Institution of Welding Engineers.—Monday, January 23rd. Caxton Hall, S.W.1. 7.30 p.m. "Electric Welding Repairs to Inflated Gasholders." Mr. A. E. Plumstead.

Institution of Electrical Engineers.—INFORMAL MEETING.—Monday, January 23rd. Institution, London, W.C. 7 p.m. "Power Factor Correction." Messrs. E. W. Dorey and C. S. Buyers.

Mersey and North Wales (Liverpool) Centre.—Monday, January 23rd. University, Liverpool. "Higher Steam Pressures and their Application to the Steam Turbine." Mr. A. H. Law and Mr. J. P. Chittenden.

North-Eastern Centre. — Monday, January 23rd. Armstrong College, Newcastle-on-Tyne. 7 p.m. "Large Electric Baking Ovens." Mr. W. Ellerd-Styles.

North Midland Centre.—Tuesday, January 24th. University, Leeds. 7 p.m. Faraday lecture. "Electricity in the Service of Man." Dr. S. Z. de Ferranti, F.R.S.

North-Western Centre.—Tuesday, January 24th. Milton Hall, Manchester. 7 p.m. Joint meeting with the Institution of Post Office Electrical Engineers. "Recent Applications of Power in the Post Office." Mr. H. C. Gunton.

North-Eastern Students' Section.—Friday, January 20th. Armstrong College, Newcastle-on-Tyne. 7.15 p.m. "Remote Control Systems." Mr. D. E. Lambert.

Scottish Students' Section.—Wednesday, January 25th. Royal Technical College, Glasgow. 7.30 p.m. "Electrical Developments in New Zealand." Mr. J. S. M. Ewart.

London Students' Section.—Friday, January 20th. Institution, London, W.C. 6.15 p.m. "The Three Cathode Carbon Arc." Dr. R. C. Fox.

Institution of Civil Engineers.—Tuesday, January 24th. Great George Street, S.W. 6 p.m. "Railway and Vehicular Bridge Across Vancouver Harbour (B.C.)." Mr. A. D. Swan.

Society of Technical Engineers (Birmingham Branch).—Tuesday, January 24th. Queen's Hotel, Birmingham. 7.45 p.m. "Scientific Management." Prof. J. F. Rees.

Electrical Power Engineers' Association (Southern Division).—Wednesday, January 25th. Institution of Electrical Engineers, London, W.C.2. 7 p.m. "The Control of Motor Convertors in Automatic Sub-stations." Mr. S. Kingsbury.

Physical Society.—Friday, January 27th. Imperial College of Science, South Kensington, S.W. 5 p.m. Ordinary meeting.

Industrial Welfare Society.—Friday, January 27th. Hotel Metropole, Northumberland Avenue. 11 a.m. Conference on Accident Prevention.

Notes.

Diesel Engine Users' Association.

The secretarial statement concerning the progress of the Association and work carried out during 1927 shows that the 47 new members and subscribers elected have increased the total membership to 472. Two of the earliest members have resigned because they now purchase supplies of electricity in bulk, and are no longer connected with the working of Diesel engine plant. For the same reason Mr. Percy Still, who has been hon. secretary of the Association since 1913, will cease to be a user soon when the Carels Diesel engine plant at Chelsea is shut down. Of the total number of subscribers, over 100 are in British Dominions and foreign countries. The demand outside the actual membership for publications continues, and the Association is frequently consulted by manufacturers, operating engineers, and prospective users seeking information.

Exposed Live Metal Parts.

A correspondent wishes to bring to the notice of our readers and others a recent incident of a guest of the house receiving a nasty electric shock, in connection with a 230-volt a.c. supply to an electric cooker. He says:—"The main board consists of a rotary main d.p. switch, two s.p. fuses, a 2-pin plug, a coloured pilot lamp (a 16-c.p. carbon-filament) fitted with an Edison screw cap, attached to a flat-back porcelain base, bakelite cover lampholder. The guest in question accidentally placed his hand on the lamp cap, which projected ⅜ in. beyond the lampholder hood cover, this, of course, being *an exposed live part*.

"In view of recent Press reports of the electrical accidents on low-voltage systems and the growth of a.c. supply at 230 volts in rural districts, &c.," says the writer, "I consider the incident worthy of joint investigation by the lamp and lampholder makers while the installation of shock-proof and fool-proof apparatus is being enforced for the safety of all concerned. Here is a case of *exposed live parts* when every care was taken by the electricians who installed the apparatus to see that efficient earthing was effected. Such accidents, which may prove fatal, must also have a tendency to retard the development of electricity supply, extensive use of such incidents being made by gas companies' canvassers."

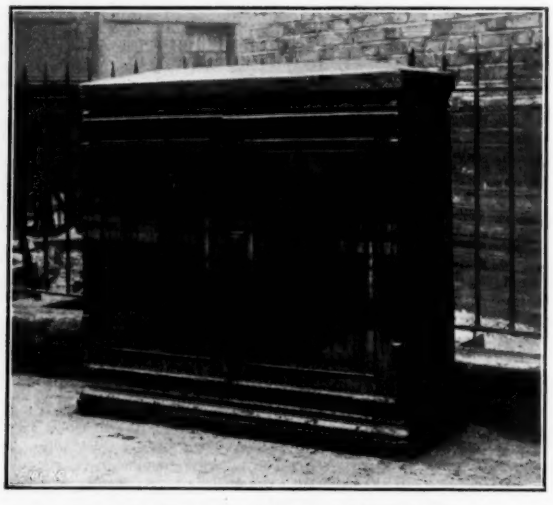
In our issue of February 12th, 1926, p. 243, we commented on a similar occurrence, which unfortunately had a fatal result, and urged that provision should be made to prevent the recurrence of such an accident. There is no necessity to use a screw cap on a cooker, and there is no difficulty in obtaining bayonet-capped pilot lamps and holders free from risk of shock. In the case of powerful gasfilled lamps the screw cap is necessary, but both lamp and holder can be made safe if attention is given to the matter.

The Recuperation of Energy on D.C. Electric Railways.

In a paper read before the French Society of Electricians at a recent conference, M. F. Guéry stated that 40,000 tons of coal, or energy worth 10 million francs, could be saved annually on the railways of Paris by adopting a system of recuperation in connection with the braking of trains, and returning energy to the mains. After reviewing the various systems that had been proposed, the author analysed the situation very fully, explaining the conditions that would have to be fulfilled in order to obtain satisfactory results. The difficulties are serious, but, nevertheless, M. Guéry considers the problem worthy of continued attention, in view of the economic advantages of recuperation which he regards as unquestionable.

The Thames Floods.

One of the areas most affected by the recent Thames floods was the Dockland quarter on the south side of the river. In Silver Street, Rotherhithe Street, Derrick Street, &c., the damage was greater than elsewhere, due to the bursting of the creosote tanks, as well as to the collapse of the dock walls. The sub-station of the Bermondsey Electricity Department at Silver Street, which controls the supply to many of the docks, was put out of action. It was flooded to a depth of 3 ft. 6 in. for 24 hours. All the h.p. gear was put out of action and the whole station was in chaos. By hard work Mr. Appleton, the engineer in charge of the station, had a temporary supply available by 9.30 p.m., but some days elapsed before it could resume full load. One of the "Henley" unit type distribution pillars was completely submerged, yet functioned perfectly when the floods had abated, although the creosote and pollution from the river had covered everything. These pillars have now been dried out and a unit is being sent to Messrs. Henley's Research Laboratories for breakdown test to ascertain what effect, if any, the creosote has had upon the micanite insulation.



A "Henley" Pillar after the Flood.

Rather alarming reports regarding the flooding at Poplar appeared in a contemporary. These suggested that *all* the feeder pillars had practically been wiped out. On the contrary, only one pillar seems to have been in serious trouble and this was due to an electrical fault. A few others were temporarily put out of commission, but this, of course, was only to be expected.

Messrs. Julius Sax & Co., Ltd., have recently acquired a large factory and wharf (situated close to Hammersmith Bridge) which suffered considerable damage due to the floods. The water made its way from the back of the premises, flooding the workshops, and putting several motors out of action. About 60 ft. of the river wall was forced into the river.

Legal.

ALLEGED FRAUDULENT PROSPECTUSES.—At the Central Criminal Court on January 16th, Sir Charles Buckworth-Herne-Soame, Bt., Col. Edmund O. Eaton, and Robert G. Harley appeared on charges relating to the issue of prospectuses in connection with the Chalk Fuel Power Gas and By-Products Corporation, Ltd. The defendants pleaded "Not guilty."

Mr. PERCIVAL CLARKE, prosecuting, said that certain statements were made in the prospectuses with a view to inducing people to take shares in the company. Col. Eaton was not a director, but he was charged with aiding and abetting those who were directors to publish false statements. It was alleged that from the inception of the company there was a conspiracy to commit offences against the law. The company was formed to exploit a mixture of chalk and tar for which a number of claims were made. Mr. Franklin, an engineer, was asked to report upon the fuel. He conducted tests, as a result of which he announced that the fuel was useless. In spite of this, statements were published under Mr. Franklin's name extolling the qualities of the product.

Mr. G. H. FRANKLIN gave corroborative evidence and the case was adjourned.

On the following day Mr. Franklin was cross-examined by Mr. Valetta, who appeared for the defence. He said that at the time of the tests he did not know that there were three grades of the fuel. He agreed that five per cent. more tar would have increased the calorific value considerably. The locomotive test was not made in a very modern engine. The fuel had been tried in a vertical boiler at Bow, and appeared to be successful. If it was successful it was, of course, more economical than coal. Mr. J. R. Belcher said that in the locomotive tests the furnace became choked.

Sir C. Buckworth-Herne-Soame said that the Suddine Company was formed in 1911, and he became a director in 1912. Its object was to make fuel of sudd grass which grew on the Nile. After experiments, they found that chalk was the most successful substance to use with other products. They estimated that the fuel could be sold before the war at about 10s. a ton; now it would be 20s. or 30s. The witness was chairman of the Chalk Fuel Co., registered in 1914. He considered that the experiments which had been referred to were successful, but he had no technical knowledge of the fuel. Until he received the summons he had not heard the slightest hint that the reports were incorrect; he was always under the impression that it was good fuel. Although he was entitled to a director's fee of £200 a year, he had only drawn £5 for petty cash.

The case was again adjourned, bail being allowed.

B.E.S.A. Publication.

The British Engineering Standards Association has recently issued a specification for Plug-in Coils for Radio-Reception Purposes (B.S.S. No. 289—1927). This, the third B.S.S. to be issued dealing with wireless material, deals with the interchangeable type of plug-in coil in which the two ends of the windings are connected to a pin and a socket respectively, the following features being standardised: Dimensions of the plug portion and the tolerances thereon, in so far as interchangeability is concerned; and a range of "sizes" based on the inductance values. Owing to fluctuation in design it has been considered inadvisable to standardise at the present time coils having intermediate tappings, but in view of the tendency towards the use of centre-tapped coils a recommendation is made in an appendix regarding the dimensions of the plug portion of such coils. The standard range of coil sizes is designed so as to include coils suitable for all wave-lengths from about 20 metres to 25,000 metres when in parallel with a condenser of 0.001 microfarad or less. The range of coils is divided for convenience into five groups, and there are five coils in each group. The induction values of the coils are so devised that the calibration chart for any one group is identical in form with that for the coils in any other group. It is thus arranged that each coil in any group gives a wavelength three times as great as that of the corresponding coil in the preceding group. The calibration chart given in the specification shows the simplicity and convenience of this arrangement very clearly. The schedule showing the wavelengths to which each coil can be tuned with various condenser-settings also indicates the corresponding kilocycle values.

Another useful feature dealt with by the specification is the standardisation of the method of connecting the ends of the winding to the plug. It is understood that at a later date a further appendix will be added dealing with a performance test for coils, the degree of performance being indicated by a "figure of merit."

Copies of the specification may be obtained from the Publications Department, British Engineering Standards Association, 28, Victoria Street, London, S.W.1, price 2s. 2d. post free.

The Electrical Equipment of Railways.

The Minister of Transport has appointed a committee to review the recommendations made with respect to the standardisation of the electrical equipment of railways and other matters by the Electrification of Railways Advisory Committee of 1921, and to report what modifications, if any, should be made in those recommendations, having regard to the developments which have taken place since that date. The membership of the Committee is as follows:—Col. Sir John W. Pringle, C.B., Chief Inspecting Officer of Railways (chairman); Sir John Aspinall; Mr. A. R. Cooper, London Electric Railway Company; Lieut.-Colonel F. A. Cortez Leigh, T.D., London, Midland and Scottish Railway Company; Sir Philip Dawson, M.P.; Sir Alexander Gibb, G.B.E., C.B.; Mr. H. N. Gresley, C.B.E., London and North-Eastern Railway Company; Mr. Herbert Jones, Southern Railway Company; Mr. C. H. Merz; Sir Philip A. M. Nash, K.C.M.G., C.B.; Mr. Roger T. Smith; Sir John Snell, G.B.E. Secretary, Mr. Thomas L. Paterson, 6, Whitehall Gardens, S.W.1.

The Minister has also appointed a committee to review the recommendations made by the Automatic Train Control Committee of 1922, and to consider and report what alterations, if any, should be made in that Committee's conclusions and recommendations. The investigations of the new committee will include the consideration of the non-contact type of train control, *i.e.*, inductive or wireless systems. No further examination, however, will at present be made of devices already considered by the Ministry of Transport involving contact between apparatus on the track and on the locomotive, respectively.

The membership of the committee is as follows:—Col. Sir John W. Pringle, C.B. (chairman); Mr. H. C. Charleton, M.P., National Union of Railwaymen; Mr. C. B. Collett, O.B.E., Chief Mechanical Engineer, Great Western Railway; Mr. E. C. Cox, C.B.E., Operating Superintendent, Southern Railway; Mr. H. N. Gresley, C.B.E., Chief Mechanical Engineer, London and North-Eastern Railway; Lt.-Col. G. L. Hall, O.B.E., Assistant Engineer, Southern Railway; Lt.-Col. A. H. L. Mount, C.B.E., Inspecting Officer of Railways; Mr. A. Newlands, C.B.E., Chief Engineer, London, Midland and Scottish Railway; Mr. E. A. Wilson, O.B.E., Engineer, Metropolitan Railway. Secretary, Mr. C. Tilden Smith.

Incorporated Municipal Electrical Association.

The preliminary programme of the thirty-third annual convention has been issued. The meeting is to be held at Bath, from June 11th to 16th, 1928. On Monday, June 11th, the President, Mr. F. W. Purse, M.I.E.E., M.I.Mech.E., engineer and manager of the West Ham Electricity Department, will hold a reception in the Pump Room. Next morning the members will assemble in the Theatre Royal, and the convention will be given a civic welcome by the Mayor of Bath (Ald. Cedric Chivers, J.P.). Afterwards Mr. Purse will deliver the presidential address, which will be followed by a paper and discussion. In the afternoon there will be a special visit to the Exhibition of Electrical Apparatus, and in the evening a reception by the Mayor in the Pump Room.

On Wednesday, June 13th, the proceedings will include a paper and discussion, a visit to places of interest, and tea with Sir Harry T. Hatt, J.P., chairman of the Bath Electricity Committee, in Victoria Park.

On Thursday, after a paper and discussion in the morning, the afternoon will be devoted to separate meetings of the Local Authority Electricity Committee members, and of the engineers, and at the same time there will be a special meeting in conjunction with the Electrical Association for Women. In the evening the annual dinner will be held.

For Friday, June 15th, the business will be confined to the annual general meeting, but in the afternoon and on Saturday there will be visits to places of interest.

Traffic Signals at Edinburgh.

The Edinburgh Corporation is recommended to introduce electric signals for the regulation of street traffic. As an experiment a signal is to be erected at the junction of Broughton Street and York Place.

Overhead-Line Regulations.

With regard to the request of Mr. W. B. Woodhouse for information on the subject of sleet on overhead wires, and our remarks on the subject last week, our attention has been drawn to the regulations of the French Government, dated April 30th last year, on the subject of electrical distribution. In Article No. 6, for the calculation of the strength of overhead lines, a pressure has to be allowed for of 72 kg. per square metre (14.7 lb. per sq. ft.) for circular conductors at the average temperature of the district, and 18 kg. sq. metre (3.6 lb. per sq. ft.) of the lowest temperature, whichever of them gives the higher figure.

In the admirable explanatory circular of the Ministry of Public Works which accompanies the regulations it is pointed out that in the calculation of overhead lines not merely the permanent stresses have to be allowed for, but also the "accidental" stresses which may be produced under the action of wind which can be influenced by the temperature.

"When it is cold, the sag of the conductors diminishes, which is unfavourable to security; but, on the contrary, in general, under these circumstances, the violence of the wind does not reach the maximum recorded at mean temperatures. . . . It is not necessary, in most cases, to consider a layer of ice covering the conductors; this layer is produced more rarely on conductors of energy than on telecommunication lines because of the heat developed by the passage of the current. However, in certain regions, for example, in mountainous countries, a layer of ice can be produced; in these special cases it must be allowed for in the calculations."

This is obviously the right attitude to take up in these matters; rules which may serve well for a line at Caithness may penalise a rural line in Kent, although the effect may be small on a heavy line. The French circular letter of April last contains a material amount of information, and shrewd observations, including many points of interest to those in other countries; it was prepared, as well as the regulations, with the co-operation of an admirable institution that has worked well in France for over 20 years—the Electrical Committee. Our authorities might well take a leaf out of the book of the French Ministry of Public Works and give explanations, reasons and suggestions to those interested in electrical matters when any modifications are made in the regulations.

It may be suggested that much of the nervousness regarding overhead lines is due to the widespread breakages of Post Office lines during heavy storms; the public does not realise that the conductors used for overhead power lines have a much greater mechanical strength and factor of safety than the class of light Post Office line that usually gives the most trouble. It is difficult to imagine an overhead power line that would offer as much obstruction to the wind as 64 wires on a pole

Electricity in Agriculture.

The Research Committee of the Royal Agricultural Society has issued its annual survey, entitled "Agricultural Research in 1926" (the Society: price 2s. 6d.), which includes, amongst a variety of topics, that of "Agricultural Engineering," dealt with by Mr. B. J. Owen, D.Sc., and covering, with an extensive bibliography, 47 pages. Under the heading of "Power" the author reviews briefly nine papers read at the World Power Conference at Basle in 1926, reported at the time in the ELECTRICAL REVIEW, and gives an account of investigations carried out in the United States. In Minnesota, it appears that the average farming load is considerably in excess of that on which economic forecasts have been based; it is further shown that it is a sound economic proposition to supply energy to farming districts where the demand and the use of it are organised, and that it is a sound economic proposition for the farmer to use electricity under proper guidance. Dr. Kühne has stated that in 1925 only 425,000, or less than 7 per cent., of the farms in the United States used electricity for lighting or power. Of these only 25,000 drew their supply from public companies; the remainder had small installations of their own. The scattered situation of American farms makes transmission and distribution from central supply systems very costly. The state of California forms an exception, where the use of electricity in the north and centre is very extensive. Electricity is there supplied for power at an average unit price of 1d.; apart from ordinary uses, it is largely employed for drying fruit; there are electric fruit-drying plants which can deal with 15 tons of fresh fruit daily. Electricity is also largely employed by poultry keepers. At Petaluma is a plant with 1,260 electric incubators, with a capacity of 564,480 eggs, consuming daily 14,000 units, or .025 unit per egg. Thus, for an incubation of 20 days the consumption is about 0.5 unit per egg, which costs about one halfpenny. "Foster-mothers," according to construction, work out per chicken for 1,000 hours between a farthing and a penny farthing. On seven New Hampshire farms the average consumption in 1925 was 1,683 kWh, increasing in 1926 to 4,253 kWh. In the latter year the figures ranged from 432 kWh for a fruit farm to 7,694 kWh for a dairy farm. The average consumption per month on four dairy farms, for milking machines, was 91.5 kWh. Milking machines are considered thoroughly practical and standard equipment in the New England district. Milkers have been installed for as few as ten cows. Electric incubation on poultry farms has been very successful, the quality and vitality of the chicks appearing to be above the average for chicks from the same hens hatched by other means. Electric brooders, owing to the severe cold prevailing during the brooding season, have not been so successful. In 1926 one hundred investigations and observations on the application of electricity to agriculture were under way in 20 States.

The use of electricity by Ontario farmers is considered very disappointing, being confined to lighting. Only 2.52 per cent. of the Ontario farms are served by the Hydro-Electric Commission, although the Government pays half the cost of rural line construction and rural lines are relieved from taxation.

In a section dealing with wind-power, references are given to a number of recent publications on the subject. The efficiency of the "wind-rose" multivaned low-speed type of wheel is given as 33.4 per cent., its peripheral speed at maximum efficiency being about 1.25 times the wind-speed (which should be measured at a sufficient distance in front of the wheel to be clear of the slowing-down of the wind near the wheel).

Under the heading "Ultra-Violet Light and Nutrition" it is stated that little doubt now remains as to the importance of ultra-violet radiation in this connection. Vitamin D is produced in the skin when it is exposed to ultra-violet radiation, and is absorbed into the circulation. Evidence is now available that irradiation of food may exercise an appreciable influence; and that exposure to ultra-violet rays increases the absorption of mineral ingredients, notably calcium, from the food.

Injuries from Cathode Rays.

Injuries caused by cathode rays, streams of electrons projected from Dr. W. D. Coolidge's recently-invented tube (see ELEC. REV., January 6th, 1928, p. 25), closely resemble burns due to overdoses of X-rays and are similarly stubborn about healing. This is indicated by experiments performed by Dr. Victor C. Jacobson and Dr. Kenneth C. Waddell, of the Albany Medical College, to be announced soon in the scientific journal, *Archives of Pathology*.

Rats were used as subjects of the experiments. The animals were wrapped in jackets of copper foil to protect them from being rayed all over, and only a spot about an inch in diameter on the upper abdomen was left exposed. They were left in front of the window of the apparatus for periods varying from one tenth of a second to six seconds daily for fourteen days, while others received only single rayings of from six seconds to a minute. Current was fed into the tube at three voltages, 100,000, 200,000 and 300,000 volts, respectively.

The first sign of effect by the cathode rays was in the change of hair colour, from white to yellow. Then the skin appeared to become tender, and finally developed pronounced sores, which were very slow to heal. When the rats were chloroformed and the skin subjected to microscopic examination, the details of the damage resembled closely those of X-ray burns. The experimenters state that it now appears highly likely that X-ray burns are really due to cathode rays generated by the impact of X-rays on solid or liquid objects which they encounter.—*Science*.

E.A.W. Activities.

The London fixtures of the Electrical Association for Women for the next few months include visits to the B.B.C. studios, London (January 25th); Lots Road power station (February 1st); and the new Westminster showrooms of the Westminster Electric Supply Corporation (March 21st). On February 15th and 16th there will be "At Homes" at 46, Kensington Court, W.8, and a one-day conference will be held on April 17th.

Appointment Vacant.

Electrical engineer and manager (£350), for the Abertillery U.D.C. Electricity Department. E.h.p. cable jointer for Guildford Corporation Electricity Works. Foreman electrician (82s. 3d.) for the Barry U.D.C. Electricity Department. (See our advertisement pages to-day.)

Fatality.

William Henry Morris, a colliery worker at Cwmfelinfach, Monmouth, received a fatal electric shock on January 15th, when taking a towel from a wire clothes line. It is believed that the wire line was in contact with a cable connecting the deceased's house with the electric main.

Congress of Radiology.

The second International Congress of Radiology, according to the *British Journal of Radiology*, is to be held at Stockholm from July 23rd to 27th, under the presidency of Prof. Gosta Forssell.

Institution Notes.

Junior Institution of Engineers.

In a paper read before the Institution on January 13th, Mr. N. E. Jackson, A.M.I.H.V.E., made a general survey of the uses and application of air conditioning, a subject on which very little has been written in this country. He enumerated some of the industries in which proper maintenance of temperature and humidity was essential for successful working, and said that air conditioning played an important part in theatres and kinemas, where absolute comfort could only be ensured by proper heating and ventilating equipment, coupled with some means of air purification and cooling in warm weather.

Royal Society of Arts.

The Society's annual competition of industrial designs will take place in June. Amongst the many prizes offered is one of five guineas for a cabinet for a wireless receiving set, and another of £25 for a showcard advertising the Henley wiring system.

Institute of Metals.

During the past year the membership of the Institute has increased from 1,801 to 1,903, and it is anticipated that the present year will witness the enrolment of the 2,000th member. The annual general meeting of the Institute will be held in London from March 7th to 8th, and the autumn meeting in Liverpool from September 4th to 7th.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

Mr. T. E. BOOTHBY, A.M.I.E.E., and a founder member of the Institute of Fuel, celebrates his silver wedding on January 26th. He was married in 1903 to Miss S. Ashworth, youngest daughter of Mr. Harry Ashworth, and sister of the late Joseph Ashworth, at one time Mayor of Oldham. Mr. and Mrs. Boothby have a host of friends in the electrical and allied industries in all parts of the country. Mr. Boothby is to-day the chief power station engineer of the Shropshire, Worcestershire and Staffordshire Electric Power Company, in which capacity he has come into contact with many new friends while he has been engaged on the design of the company's new super-power station at Stourport, Worcestershire. He commenced his electrical career with Messrs. Ferranti, Ltd., at Hollinwood, for whom he was in charge of many central station contracts, and since then he has been connected at various periods with the Charing Cross and Strand Electricity Supply Co., Fleetwood and Oldham electricity supply undertakings, Stalybridge and Dukinfield Tramways and Electricity Board, the L. & N.W. Railway at Stonebridge Park, and with Messrs. Thomas Firth & Sons, of Sheffield. From this imposing list we are confident in believing that Mr. and Mrs. Boothby will be deluged with congratulations and good wishes on this very happy occasion.

Mr. R. A. WRIGLEY, "Keld," Somerset Avenue, Wilpshire, near Blackburn, late chief draughtsman for Messrs. Yates and Thom, Ltd., of Blackburn, has started practice as consulting and mechanical engineer, and is anxious to receive electrical manufacturers' catalogues.

Mr. GEORGE H. HOLDING, late of Messrs. Long & Crawford, Ltd, of Manchester, has been appointed manager of the Switchgear Works of Messrs. Drake & Gorham, Ltd., at Rockingham Works, Newington Causeway, London, S.E.1.

Mr. ERNEST LEETE, managing director of the London Electric Wire Company & Smiths, Ltd., has been elected chairman of the Cable Makers' Association for the current year. Mr. Leete is also a director of the Liverpool Electric Cable Co., Ltd., the Weald Electricity Supply Co., Ltd., and the Indestructible Paint and Standard Varnish, Ltd. He is a member of Council of the Institution of Electrical Engineers. It may interest our readers to know that the London Electric Wire Co. was one of the foundation members of the Cable-Makers' Association, and was represented at the famous dinner held 28 years ago, at which the final agreement was arrived at. Since that date the company has been constantly manufacturing cables in accordance with the standards and specifications of the Association.

Mr. J. E. HADFIELD, who is leaving the staff of the British Thomson-Houston Co., Ltd., Rugby, after 25 years' service, has been presented by his colleagues with a case of cutlery.

St. Helens Town Council has adopted a recommendation by the Parliamentary Committee to pay the late electrical engineer, Mr. RENDELL BAKER, who is proceeding to Halifax, £50, and £3 3s. a day and expenses, for three months' service as consulting engineer. The Electricity Committee had recommended that Mr. Baker should be retained as consulting engineer for six months at a fee of £200.

On the occasion of his coming of age, Mr. JOHN MARSDEN, son of Mr. J. W. Marsden, of J. Marsden & Sons, electrical engineers, of Huddersfield, has been presented with a clock by the employés.

The Barrow Electricity Committee recommended that the salary of Mr. H. R. BURNETT, the borough electrical engineer, be increased in response to his application. The Finance Committee said that the Committee ought to state the amount of the increase. At the Council meeting it was suggested that a statement be prepared of comparative figures relating to the staff in 1914, units generated, &c. The matter was referred back to the Electricity Committee for further information.

The *Western Mail* reports that Mr. M. J. MORTIMER, electrical engineer to the Abertillery District Council for the past six years, recently tendered his resignation, but the Council decided not to accept it in view of his excellent record. He is to be interviewed by a deputation.

Mr. A. H. BARKER, M.I.C.E., has been appointed consulting engineer of the million-pound rebuilding scheme of the University of Leeds, for which Messrs. Lanchester, Lucas and Lodge are the architects.

A South African contemporary states that Mr. P. E. GREGSON, A.M.I.E.E., is the president-elect of the S.A. Institute of Electrical Engineers for the year 1928.

Owing to ill-health, Mr. A. N. DIXEY, A.M.I.E.E., resigned his position as electrical engineer to the Great Indian Peninsula Railway in Bombay in December last, after seventeen months' leave in England. Before leaving India he was presented by the supervising staff with a cheque for £40 for a wireless set. He had been 21 years in the service of the Railway, and is now hoping to take up work in England. His address is "Dil Kushi," Little Kingshill, Great Missenden, Bucks.

Councillor G. W. BROWN has resigned as chairman of Lytham St. Annes Electricity and Tramways Committee. He disagrees with the Council's financial policy, and since the amalgamation of Lytham and St. Annes has strongly opposed the practice of devoting electricity profits to meet tramway losses.

Obituary.—MR. J. W. HARRIS.—The death took place on Saturday last, at his residence, Woodthorne, Wergs Road, Tettenhall, near Wolverhampton, of Mr. Jas. Wilfred Harris, M.I.C.E., M.I.E.E., &c. Mr. Harris, who was 53 years of age, was articled to the Electric Construction Co., Wolverhampton, and on completion of his articles travelled round the world. He worked on an electrical engineering plant in British Columbia, and spent some time with the Westinghouse Company at Pittsburg. Later he was associated with the Westinghouse Company's works at Trafford Park, Manchester, and for a time he was electrical engineer of the Dominion Iron and Steel Company, Nova Scotia. Returning to this country, Mr. Harris joined the firm of Alfred Wiseman, Ltd., Birmingham, of which he was governing director.

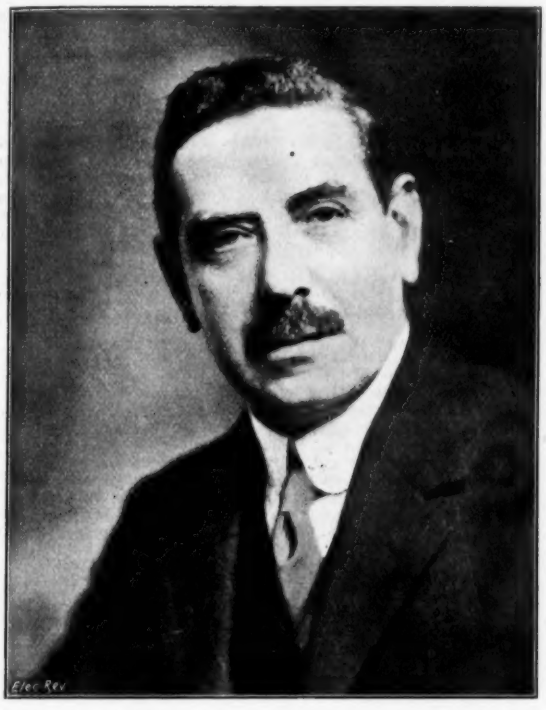
MR. A. PESCATORE.—We regret to record that M. Antoine Pescatore died on December 16th in Brussels at the age of 61 years. He was, according to *The Times*, a member of a historic Luxemburg family, but qualified as an engineer. He had been a member of the Institution of Electrical Engineers since 1898. He came to this country in 1895, and established the manufacture of Tudor accumulators here. When the business was taken over by the Tudor Accumulator Co., Ltd., in 1897, he became managing director of that company, and retained that position for 22 years until 1919, when he retired owing to ill-health and returned to Luxemburg, where he joined the Luxemburg Government as Minister of Public Works. In 1920 he resigned that office and was appointed Chargé d'Affaires at the Court of St. James's.

Mr. H. D. JACKSON.—Mr. Harold D. Jackson, of Messrs. Barr & Stroud, Ltd., the well-known engineering and scientific instrument makers, of Anniesland, Glasgow, has died at the age of 57 years.

MR. R. SCOPE.—The death occurred on Saturday, at Gateshead, at the age of 76 years, of Mr. Robert Scope, a director of Messrs. Clarke, Chapman & Co., Ltd. He began life as a gate-boy with the firm, at 13 entered the office, later he became secretary, and 25 years ago joined the board.

MR. A. B. SPENCER.—Councillor A. B. Spencer, chairman of the Electricity Committee of the Gainsborough Urban Council, died last Friday, following an operation. He was 48 years of age.

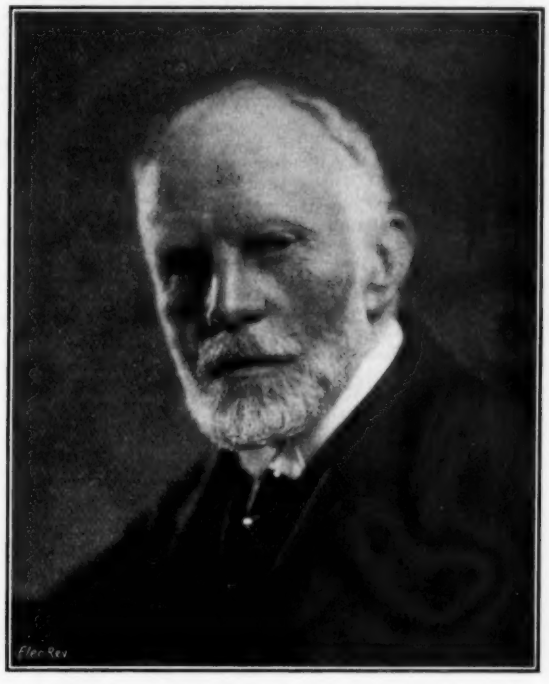
MR. C. VERNIER.—It is with feelings of the deepest regret that we have to record the death of Mr. Charles Vernier, M.I.E.E., who, on February 1st, 1927—less than a year ago—became chief engineer of the Macintosh Cable Co., Ltd., after having been with the Newcastle-upon-Tyne Electric Supply Company from 1900 until that date. We gave a full account of his career in the ELECTRICAL REVIEW of January 21st, 1927 (p. 105), when he took up his new appointment, and referred at that time to the important work that he had done in high-pressure cable installation, he having laid down the first 66,000-volt cables and 66,000-volt overhead transmission lines in Great Britain between 1923 and 1927. He was a member of the Overhead Lines Regulations Committee and had read a number of papers before the Institution of Electrical Engineers on cable and wayleave matters. He was an expert of great distinction whom the industry could ill afford to lose at any time, and especially now when his particular department of activity ranks so prominently in the electrical development problems of the day. Mr. Vernier, who was only 51 years of age, had to leave his duties towards the end of last October owing to a nervous breakdown. Under advice he went to the South of Ireland, and subsequently entered a nursing home, where he died of pneumonia.



Elliott & Fry [*London.*

The late Mr. Charles Vernier.

MR. R. P. SELLON.—The news of the death of Mr. Robert Percy Sellon will be received with feelings of deep regret by large numbers of our readers. He passed away suddenly of heart failure on January 11th, at the age of 64 years, at Albury Edge, Merstham, and the funeral took place at Merstham on Monday afternoon. Mr. Sellon was born in 1863, a son of Col. Robert Sellon, R.E., and he received his technical education at the City and Guilds of London Technical College under Professors Ayrton and Perry. After being connected with some very early electric lighting installations, he joined the staff of the Brush Electrical Engineering Company, Ltd., and advanced through various capacities to the position of general manager and director. He sat on that board for many years, but his more recent interests have been the County of London Electric Supply Co., Ltd., the Bournemouth and Poole Electricity Supply Co., Ltd., and Waygood-Otis, Ltd., of which he was a director, and Messrs. Johnson, Matthey & Co., Ltd., of which he was managing director. He was a member of the Institution of Electrical Engineers, and had been on the Council. He had at some time or other travelled in most parts of the world studying electrical affairs, and in his earlier years was a valued contributor to the pages of the ELECTRICAL REVIEW, his knowledge of the problems of the electrical industry before its present state of developed organisation and when it had fewer competent, but perhaps more unattached, publicists, qualifying him as a sound adviser on many matters relating to plant production.



Elliott & Fry [*London.*

The late Mr. R. P. Sellon.

Wills.—Mr. T. J. WEST, who recently died at the age of 87 years, left £28,931 gross and £27,967 net personalty. He was formerly connected with J. Stone & Co., Ltd., of Deptford.

Mr. F. E. HUGHES, once secretary of the Manchester Corporation Electricity Department, left £15,022.

Financial Section.

New Companies, Returns of Share Capital, Debenture Changes, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

Electric Service Co. (Grimsby), Ltd.—Private company. Registered January 11th. Capital, £1,000 in £1 shares. Objects: To acquire the business of electrical engineers, &c., heretofore carried on as "The Electric Service Co." at Grimsby, Lincs., and elsewhere. The permanent directors are:—N. K. B. Harrison, 49, Suggitts Lane, Cleethorpes; E. A. Dutton, 323, Cleethorpes Road, Grimsby. Secretary: N. K. B. Harrison.

Ruths Steam Accumulators, Ltd.—Private company. Registered January 11th, with a nominal capital of £75,000 in £1 shares. The objects are to acquire and hold any licence or licences in respect of steam accumulators under the British patents held by Aktiebolaget Vapor-Akumulator, of Stockholm, Sweden, to carry on the business of mechanical and electrical engineers, manufacturers of and dealers in plant and machinery of all kinds, metallurgists, manufacturers of and dealers in steam accumulators and devices of all kinds for improving the efficiency of steam plants, &c. The subscribers (each with one share) are:—W. Hart, 40, Colenso Road, Seven Kings, Ilford, accountant; C. F. Butler, 331, Lordship Lane, East Dulwich, S.E.22, clerk. Qualification, £100 shares. Solicitors: Neve, Beck, Son & Co., 21, Lime Street, E.C.3.

Essaness Radio and Electrical Co., Ltd.—Private company. Registered January 7th. Capital, £1,000 in £1 shares. Objects: To adopt an agreement with S. C. Slaughtern for the purchase of his business now carried on at 149, Ewell Road, Surbiton, and to carry on the business of electricians, radio instrument manufacturers and repairers, mechanical engineers, &c. The subscribers (each with one share) are:—G. W. Boundy, 53, Cannon Street, E.C.4, solicitor's clerk; Miss Dorothy Birkett, 102, St. John's Road, N.1. The first directors are S. C. Slaughtern and G. Hough. Qualification, one share. Solicitors: Kenneth E. Bartlett & Co., 83, Cannon Street, E.C.4.

Gibbs & White, Ltd.—Private company. Registered January 11th. Capital, £2,500 in £1 shares (500 7 per cent. cumulative preference and 2,000 ordinary). Objects: To acquire the business of radio and general engineers and contractors carried on by S. Gibbs and G. V. White at Marconiphone House, 395, Shirley Road, Southampton, as "Gibbs and White." The first directors (to number not less than two or more than five) are:—S. Gibbs, North Stoneham, Eastleigh, wireless trader; R. P. Cleary, Clare House, Regent's Park Road, Shirley, Southampton, engineer; G. V. White, 395, Shirley Road, Southampton, company secretary (all permanent). Qualification: £500. Secretary: G. V. White.

Direct Electric Lamp Co., Ltd.—Private company. Registered January 12th. Capital, £500 in £1 shares. Objects: To carry on the business of electric lamp importers and distributors, dealers in wireless valves and accessories, &c. The subscribers (each with one share) are:—A. Kinge, 25, Glenburnie Road, Upper Tooting, S.W.17, clerk; S. A. Excell, 50, Walmer Road, North Kensington, W.10, clerk. Registered office: 72, Shoe Lane, E.C.4.

Meifod Electricity Co., Ltd.—Registered January 12th. Capital, £100 in 5s. shares. Objects: To acquire the business of generators and distributors of electric current now carried on by the Meifod Electricity Committee at Meifod, Montgomeryshire. The directors are:—A. W. W. Wynn, C. Davies, E. Jones, O. Evans, D. Owen, W. Everall, and E. Lewis, all of Meifod S.O., Montgomery. Solicitor: E. L. Jones, Llanfyllin, Montgomery.

Barri Sun Ray Institute, Ltd.—Private company. Registered January 9th. Capital, £1,000 in £1 shares. To carry on the business of medical and general electricians, masseurs, &c. The first directors are:—Mrs. L. Gillinson, 1, St. Martin's Terrace, Chapeltown, Leeds, managing clerk; H. Lightman, "Kingswood," Sholebroke Avenue, Chapeltown, Leeds, corporate accountant. Secretary: H. Lightman. Registered office: 7a, Westminster Buildings, New York Street, Leeds.

Ridged Cone Co., Ltd.—Private company. Registered January 13th. Capital, £100 in £1 shares. Objects: To carry on the business of electrical and wireless engineers, manufacturers and repairers of and dealers in wireless and radio apparatus, &c. The subscribers (each with one share) are:—G. Hovey, 9, Tregothnan Road, Stockwell, S.W.9, wireless engineer; C. Fairs, 60, Camden Street, Camden Town, N.W., stores manager. W. Hyams is the first director, with power to appoint others. Solicitors: R. C. Bartlett & Co., 44, Bedford Row, W.C.1.

Brentwood District Electric Installations Ltd.—Private company. Registered January 12th. Capital, £1,000 in £1 shares. To carry on the business of electricians, electrical engineers, contractors, constructors of all necessary cables, wires, lines, accumulators and lamps, &c. The first directors are:—H. E. Wood, Hutton Manor, Brentwood, Essex (director of Brentwood District Electric Co., Ltd.); A. G. Collis, 25, New Road, Brentwood, electrical engineer; J. Sherborne, 40, Redlands Road, Reading, timber merchant; J. W. Vincent, "The Knoll," Hutton Manor, Essex, C.A. Secretary: J. W. Vincent. Registered office: 53, New Broad Street, E.C.2.

Official Returns of Electrical Companies.

Electric Light Insurance and Maintenance Co., Ltd.—Particulars filed of £5,000 second debentures, authorised September 14th, 1927, charged on the company's property, present and future, including uncalled capital (subject to first mortgage debentures), the amount of the present issue being £560.

Shoreham and District Electric Lighting and Power Co., Ltd.—Issue on December 31st, 1927, of £800 second debentures, part of a series already registered.

Pontypool Electric Light and Power Co., Ltd.—Particulars filed of £15,000 debentures, authorised November 2nd, 1927, charged on the company's property, present and future, including uncalled capital, the amount of the present issue being £5,450.

"S. A. Cutters," Ltd.—Capital, £3,000 in 1,000 preference and 2,000 ordinary shares of £1 each. Return dated November 15th, 1927. 2,000 ordinary shares taken up. £1,000 paid. £1,000 considered as paid. Mortgages and charges nil.

Siemens-Schuckert (Great Britain), Ltd. — Capital, £10,000 in £1 shares. Return dated November 19th, 1927. 200 shares taken up. £200 paid. Mortgages and charges nil.

Birmingham District Power and Traction Co., Ltd.—Capital, £700,000 in 250,000 preference and 450,000 ordinary shares of £1 each. Return dated June 1st, 1927. 146,846 preference and 412,934 ordinary shares taken up. £559,780 paid. Mortgages and charges: £272,034 4½ per cent. debenture stock.

Richmond (Surrey) Electric Light and Power Co., Ltd.—Capital, £200,000 in £1 shares. Return dated April 21st (filed July 27th), 1927. All shares taken up. £200,000 paid. Mortgages and charges nil.

Ashton Electrical Co. (Preston), Ltd.—Capital, £1,500 in 250 founders' and 1,250 ordinary shares of £1 each. Return dated June 1st, 1927. 200 founders' and 1,033 ordinary shares taken up. £1,083 paid. £150 considered as paid. Mortgages and charges at date of return, nil. Since registered: Mortgage dated September 30th, 1927, to secure £300; and second mortgage, dated October 1st, 1927, to secure £200.

Magnus Volk, Ltd.—Capital £5,000 in £1 shares. Return dated May 19th, 1927. 4,102 shares taken up. £102 paid. £4,000 considered as paid. Mortgages and charges, £1,400.

Seaton and District Electric Light Co., Ltd.—Capital, £10,000 in £1 shares. Return dated June 18th, 1927. 6,841 shares taken up. £6,841 paid. Mortgages and charges, £6 000. Return of allotments, made up to November 8th, 1927, shows 1,009 shares allotted, payable in cash, and fully called up.

J. G. White & Co., Ltd.—Capital, £350,000 in 360,000 ordinary shares of 4s. each and 278,000 ordinary shares of £1 each. Return dated July 6th, 1927. 360,000 4 per cent. ordinary shares taken up. £66,000 paid on 330,000 shares. £6,000 considered as paid on 30,000 shares. Mortgages and charges nil.

L. W. Douthwaite & Co., Ltd.—Capital, £7,000 in £1 shares. Return dated October 18th, 1927. 5,519 shares taken up. £1,321 paid. £4,198 considered as paid. Mortgages and charges nil.

Simplex Conduits, Ltd.—Capital, £100,000 in 10,000 preference shares of £5 each and 50,000 ordinary shares of £1 each. Return dated November 3rd, 1927. 10,000 preference and 40,000 ordinary shares taken up. £50,000 paid on 10,000 preference shares. £40,000 considered as paid on 40,000 ordinary shares. Mortgages and charges nil.

Pacific and European Telegraph Co., Ltd.—Capital, £100,000 in £10 shares. Return dated November 10th, 1927. All shares taken up. £4 per share called up. £40,000 paid. Mortgages and charges £66,500.

West India and Panama Telegraph Co., Ltd.—Capital, £2,445,630 in 34,563 first preference, 10,000 second preference, and 200,000 ordinary shares of £10 each. Return dated October 6th, 1927. 34,563 first preference, 4,669 second preference, and 88,321 ordinary shares taken up. £1,275,530 paid. Mortgages and charges £89,100.

Pirelli, Ltd.—Capital, £250,000 in £1 shares. Return dated November 25th, 1927. 200,000 shares taken up. £200,000 paid. Mortgages and charges nil.

Llangefni Electric Light and Power Co., Ltd.—Capital, £3,000 in 2,750 preference and 250 ordinary shares of £1 each. Return dated July 11th, 1927. 2,566 preference and 250 ordinary shares taken up. £2,566 paid. £250 considered as paid. Mortgages and charges £2,400.

Silgolum, Ltd.—J. H. Rule, of Ashbrook, 57, Norfolk Road, Seven Kings, Essex, was appointed receiver on December 30th, 1927, under powers contained in debentures dated July 21st, September 29th, and November 16th, 1927.

Elliott Bros. (London), Ltd.—Satisfaction to the further extent of £6,000 on December 29th, 1927, of debentures dated July 19th, 1916, securing £30,000. (Amount outstanding £15,000.)

City Notes.

Para Electric Railways and Lighting Co., Ltd.

A scheme for dealing with the arrears of dividend upon the 6 per cent. cumulative preference shares, amounting to £136,500, has been drawn up by the board. It is pointed out that there is no hope of discharging certain monetary obligations within a reasonable time, due to the stabilisation of the milreis at under 6d., as against the par value of 1s. 4d. It is proposed to reduce the issued capital from £715,000 to

£481,000 by writing 12s. off the 390,000 ordinary shares of £1 each. Then these shares (8s. paid) will be divided into shares of 1s. 4d. each—making 2,340,000. Of these the existing holders will retain 780,000 and 780,000 of the remainder will be issued to the preference shareholders as consideration for consent to their holdings becoming ordinary shares and for waiving dividend arrears. The balance of the shares (780,000) will be held by the trustees for the debenture holders. They may be consolidated into £1 shares, and there are certain reservations attaching to them. The scheme will be presented at an extraordinary meeting on January 23rd.

Upon the scheme becoming operative the capital of the company will be increased to £780,000 by the creation of 234,000 new ordinary shares of £1 each.

Stock Exchange Notices.

Application has been made to the Committee to allow the following to be officially quoted:—

Electric Supply Corporation.—50,000 ordinary shares of £1 each, fully paid, Nos. 200,001 to 250,000, and 81,300 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 168,701 to 250,000.

The undermentioned have been ordered to be officially quoted:—

Marconi's Wireless Telegraph Co., Ltd.—3,250,038 ordinary shares of 10s. each fully paid, Nos. 1 to 500,000, 750,001 to 3,000,065, 3,500,001 to 3,670,317, 3,670,321 to 3,847,415, 3,847,437 to 3,966,022 and 3,906,026 to 400,000,000.

Marconi's Wireless Telegraph Co., Ltd.

Inquiries having recently been made as to the conversion rights of holders of the company's debenture stock, the directors announce that a sufficient number of ordinary shares of £1 each are available for those stockholders desirous of converting in accordance with the terms of issue of the stock. Each £3 of debenture stock held entitles the holder to one fully-paid ordinary share of £1 with dividend rights equivalent to those of two 10s. shares. A quotation on the London Stock Exchange will be obtained for the £1 shares to be so issued.

Windsor Electrical Installation Co., Ltd.

The Metropolitan Electric Supply Co., Ltd., has made an offer to the shareholders of this company and its associated concern, the Slough and Datchet Electric Supply Co., Ltd., for the acquisition of their holdings. The Metropolitan Company proposes to pay 40s. 6d. each for the £1 ordinary shares, subject to a deduction of 1s. 6d. per share for the purpose of providing for certain members of the two companies' staffs, or 39s. net. The directors of the companies recommend the shareholders to agree to the proposals.

Brazilian Traction, Light and Power Co., Ltd.

Reuter states that the shareholders, on January 5th, ratified the directors' recommendation to increase the capital stock from $120,000,000 to $200,000,000, and also the recommendation for the re-division of stock. The new stock will appear probably about May 1st.

The ordinary shareholders have received a circular offering for subscription additional ordinary shares in the increased capital of the company.

Anglo-American Telegraph Co., Ltd.

The following dividends have been declared: A final dividend of £1 10s. per cent. on the consolidated ordinary stock, making £3 15s. per cent.; final dividend of £1 10s. on the preferred stock, making £6 per cent.; and a first and final dividend of £1 10s. per cent. on the deferred shares, as for 1926.

Metropolitan Railway Co.

The final returns of revenue for the past year show that the total receipts during 1927 were £1,779,600, as compared with £1,686,600 in 1926. The larger part of the increase was due to higher passenger revenue.

Traction and General Investment Trust, Ltd.

A final dividend of 11 per cent. has been declared on the ordinary stock, making 15 per cent. for the year, as compared with 14 per cent. for 1926.

Electrolytic Zinc Co. of Australasia, Ltd.

A dividend at the rate of 12 per cent. per annum has again been declared on the whole of the issued shares in respect of the half-year ended December 31st last.

Quebec Power Co.

A dividend of $0.5 per share has been declared on the common shares for the quarter ended December 30th.

Calgary Power Co.

A dividend of 1¼ per cent. has been declared.

French Companies.

The *Société pour l'Equipement Electrique des Véhicules* reports net profits of 724,000 fr. for 1927; the dividend is 30 fr. per share.

The *Société Financière Electrique* reports net profits of 6,804,000 fr. for 1926-27, and dividends of 35 fr. per first preference share, 5.15 fr. per second preference share, and 1.25 fr. per ordinary share are being paid.

Stocks and Shares.

MONDAY EVENING.

As was to be expected, activity was apparent in practically every section of the Stock Exchange during the week under review. Speculation has again been rife in the industrial market, where an enormous business has been done to the accompaniment of spectacular movements. The Gilt-Edged Market has inclined to dullness in spite of the gold influx, but the Foreign Government Bond Market has shown considerable activity, with interest focused on certain of the Chinese bonds. The new Greek 6 per cent. loan is expected to make its appearance in a few days, probably somewhere round 91. There was a little more interest taken in oils, and the only dull spot was the Rubber Market, where a disappointing commodity return resulted in almost extinguishing the interest which had reared its head during the previous week.

Home Rails.

Metropolitans have again been the feature in the Home Railway Market, moving to the accompaniment of merger rumours in a rather erratic manner. Profit-taking early in the week dropped the price to 70, from which there was a sharp recovery of 3¼ points, which was subsequently lost. The market is inclined to the view that at anything under 70 the stock is a good speculative lock-up. Undergrounds have again been very active, a large number of shares changing hands. At 21s. 4½d. a gain of 4½d. is recorded. The income keep steady at 109. Central London 4 per cent. have moved up another two points, and Districts at 69 have more than regained their drop of the previous week. In the heavy group things have inclined to be weak, with Southern deferred a dull spot at 36.

Electricity Supply.

Continued activity was seen in the Home Electricity section, where a large investment demand was encountered. St. James' in the London group are better at 27s. It is believed that a new issue of ordinary shares is shortly forthcoming here. Yorkshire Electric are better at 33s., and here again a new issue is expected in the early spring. Urbans have added 2s. 6d. to their quotation at 40s., and, as mentioned before in this column, appear to be fully valued for the time being. Electric Supply ordinary at 35s. have again been in demand on prospects. The Metropolitan Electric Supply Company is offering 40s. 6d. for the ordinary and 20s. for the preference shares of the Windsor Electrical Installation Company, and the Slough and Datchet Electric Supply Company, two distributing concerns, operating in its bulk supply area. The market is speculating as to which will be the next to be bought up, as there are still a few independent distributing companies within the area of the Metropolitan Company. Scottish preference shareholders need not be alarmed at the drop of 6s. 6d. to 22s. in the price of their shares this week. What actually happened was that the dividend on these shares has been reduced from 8 per cent. to 6 per cent., the actual number of shares being increased by one-third in compensation. The quotation of 22s. is for the 6 per cent. preference shares in their new state. In effect the price remains unchanged. Newcastles are again harder, and Egham and Staines ordinary have been in small demand on hopes of a return to the 1925 rate of distribution (7 per cent.) as against 5 per cent. for the last year. London Electric Supply ordinary are unaltered on the announcement that the company have sold their generating plant outright to the London Power Company, and will thus be financially in a position to carry on their undertaking without raising fresh capital for many years to come.

Electricity Abroad.

The Atlas Light & Power Company have some £900,000 5 per cent. debenture stock outstanding, and have the right to issue further stock ranking *pari passu*. They are about to issue £220,000 in part payment for an undertaking which they have recently purchased. There is some little legal difficulty in the way of increasing the original sinking fund to cover the proposed new issue, and the company are seeking powers from the existing debenture holders to rectify this. Holders will be well advised to send in their proxies in favour of the proposed resolutions, as otherwise there will be two separate stocks which is, under the circumstances, quite unnecessary, and will tend to restrict marketability. A large business has again been done in the ordinary shares of this concern round about 18s., with the 7 per cent. preference in demand at 21s. 6d. Mexican Light and Power common failed

to maintain their rise of the previous week, and at 67 are two points down. The 4 per cent. second preference at 60s. have again appreciated, and the 5 per cent. bonds are a point higher at 82¼. South African Power and Lighting ordinary have again been an active spot at 25s. on dividend prospects with the 7 per cent. preference in demand as a high yielding investment at 22s. Kalgoorlie Electric have been asked for, and are better at 8s. 6d.

Cables and Wireless.

A movement of prime importance to cable shareholders was disclosed during the week, when it was announced that the wireless and cable companies had asked Sir William Plender and Sir Gilbert Garnsey to co-operate "with a view to making a joint report as to possible arrangements in the joint interest of the respective companies." It is, of course, a long step from appointing such a committee to a working arrangement becoming a *fait accompli*, but the news electrified the market, and resulted in much activity and increases in quotations in practically every instance. Market opinion has swung right round, and it looks as if the upward movement has not yet spent itself. Marconis shared in this activity, moving in a most lively manner, eventually ending the week unchanged at 50s. The debenture stock has risen sharply to 140 on the official announcement that the reduction of capital did not affect the right to convert into £1 ordinary shares at 60s., which is equivalent to converting into 10s. ordinary at 30s. Marconi Marines touched 38s. 9d., but afterwards reacted a little, whilst Canadian Marconi are practically unchanged at 15s. 3d. The Great Northern Telegraph Company propose to issue gratis, to a trust company to be formed for the purpose, 50,000 £10 shares. The trust company will have a capital of £450,000 in £3 shares, which will be given as a bonus to existing holders of Great Northern Telegraph shares on the basis of one £3 share of the trust for each one £10 Great Northern Telegraph share. The scheme has met with a mixed reception in the market, nobody professing to understand the necessity for the rather roundabout way of doing things.

Manufacturing.

There are not a lot of price movements to report in this section, although business was on quite a substantial scale. Of Electrical Equipment shares, both Metropolitan-Vickers and Siemens were again in inquiry, and hardened. General Electrics were unmoved, Crompton-Parkinson 6 per cent. preferred at 16s. 9d. were being taken off the market for investment purposes, and amongst the lesser-known ones Aron Electricity Meter ordinary and preference were dealt in at 16s. and 17s. 6d., respectively. It has been pointed out by a dealer, as a matter of curiosity, that as this company has no debentures or loans outstanding and has permanent investments in British Government securities more than sufficient to cover its preference capital, a purchase of these 6 per cent. preference at 17s. 6d. is the equivalent to an investment in British Government stocks on a 6¾ per cent. basis! English Electric issues were inclined to sag. British Aluminium ordinary were again in fairly active demand, but later experienced a little profit-taking, which kept the price at the previous week's level of 50s. There has been a certain amount of "lock-up" buying of the lower-priced shares of the heavy industries group, which resulted in a harder tendency. Telegraph Construction ordinary at 24½ recovered their previous week's drop, and Babcock and Wilcox are again better at 63s. 9d.

Tramways.

Tramways presented no distinct feature, price movements being of a minor character. Brazil Tractions are unchanged at 222½. The scheme for splitting the shares has now been passed, but it is understood that it will not be possible to deal in the no-par-value shares until about April. Shareholders are about to be given the right to subscribe at par for new $100 shares on the basis of one new share for every five old shares held. Payments are spread well over the year, and after December each $100 fully-paid share will be converted into four shares of no par value. This constitutes a very useful bonus as, based on the present price of existing shares, the "rights" should be in the neighbourhood of 20. That is to say, a holder of five old Brazilian Traction common should be able to sell his right to apply for one new share for about £20. British Columbia Electric Railway deferred continued their upward movement, and are now 195½, a net gain of three points, after having been slightly higher. The preferred followed suit by climbing to 158, as against 152½. The preference shed the dividend, but afterwards recovered most of it at 93½ x.d. The 4½ per cent. debenture again placed a point to its credit, and at the present price of 84½ yields only a shade over 5 per cent. Mexico Tramway issues were inclined to weakness for no apparent reason, the 5 per cent. bonds losing three points at 76. The London group was again lifeless, but Lancashire United Transport ordinary were in demand on the persistently good traffics, and have improved to 8s. The Para Electric Railway Company have issued a reconstruction scheme whereby, in a nutshell, each £1 ordinary share becomes 2s. 8d. in new ordinary, and each £1 preference share becomes 23s. in new ordinary. This has resulted in rather a curious anomaly, as the ordinary are 2s. 9d., equal to par in new ordinary and the preference 14s., equal to about 60 per cent. in new ordinary. Whilst these prices remain substantially as they are it would pay ordinary shareholders to sell out and buy the preference shares.

Share List of Electrical Companies.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1925.	Dividend. 1926.	Price Jan. 16 1928.	Rise or fall.	Yield. p.c.
	£					
Bournemouth and Poole	1	14†	14†	60/6	—	4 12 10
Brompton Ordinary	1	10	8⅞	25/-	—	5 12 0
Charing Cross Ordinary	1	15	8½	26/-	—	5 7 8
do. do. 4½% Pref.	1	4½	4½	17/6	—	5 2 10
Chelsea	1	12	8¾	25/6	—	5 9 10
City of London	1	15	10	30/-	—	4 13 4
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Clyde Valley	1	8	8	33/-	—	5 0 0
County of London	1	15	7½	29/-	+6d.	4 16 7
do. do. 6% Pref.	1	6	6	23/-	—	5 4 4
Edmundson's Ordinary	1	8	10	45/-cd	—	4 8 11
do. 7% Pref.	1	7	7	25/6xd	—	5 9 10
Elec. Supply Corporation	1	11	11	35/-	+1/3	6 5 9
Kensington Ordinary	1	15	8	26/-	—	5 7 8
Lancs. Light and Power	1	7½	7½	27/-	—	5 11 1
London Electric	1	10	8½	25/6	—	5 9 10
do. do. 6% Pref.	5	6	6	5⅝	—	5 11 3
Metropolitan	1	11	8	30/-	—	4 13 4
do. 4½% Pref.	1	4½	4½	17/-xd	—	5 8 6
Midland Counties	1	6	6	24/-	—	5 0 10
Newcastle-on-Tyne Ordinary	1	7	5	23/9	—	4 4 3
do. 5% Pref.	1	5	5	17/6	—	5 14 3
do. 7% Pref.	1	7	7	25/-	—	5 12 0
Notting Hill 6% Pref.	10	6	6	10⅞xd	—	5 11 7
North Met. Elec. 6% Pref.	1	6	6	22/6	—	5 6 8
St. James' and Pall Mall	5	17½	8	27/-	+6d.	5 3 8
South London	1	15	8½	25/6	—	5 9 10
South Metropolitan Pref.	1	7	7	1¼	—	6 3 0
Urban Ordinary	1	7	7	40/-	+2/6	3 10 0
do. 6% Pref.	1	6	6	1⅞	—	5 13 0
Westminster Ordinary	1	15	8½	25/6	—	5 9 10
Whitehall Elec. Invst. 7½% Pref.	1	7½	7½	21/4½	—	7 0 4
Yorkshire Elec.	1	8	8	33/-	+1/-	4 17 0

HOME RAILS.

Central London Ord. Assented	Stock	4	4	74	+2	5 8 1
Metropolitan	,,	5	3	70	—	4 5 9
do. District	,,	3½	3½	69	—1½	5 1 5
Underground Electric	£1	Nil	1⅓	21/4½	+4½d.	1 7 10
do. do. Income	Bonds	6	6	109	—	5 10 1

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	97½	+4	6 3 1
do Def.	,,	1½	1½	24½	+½	6 3 9
Automatic Telephone	1	3	10	46/3	—	4 6 6
Chili Telephone	5	5	6	7⅝xd	—	3 18 3
Eastern Extension	10	10	10	15½xd	+1	*6 9 10
Eastern Tel. Ord.	Stock	10	10	147½xd	+7½	*6 15 7
Globe Tel. and T. Ord.	10	10	10	15½	+¾	*6 9 0
do. do. Pref.	10	6	6	10½	—	5 4 6
Great Northern Tel.	10	20	20	41	+½	4 17 7
Indo-European	25	8½	10	35	—	*6 1 5
Marconi	10/-	Nil	5	50/-	—	2 0 0
Marconi-Marine	1	7½	8¾	36/3	—	4 16 7
Oriental Telephone Ord.	1	12	12	50/-	—	*4 16 0
United R. Plate Tel.	5	8	8	10⅜	+⅜	*3 17 1
Western Telegraph	10	10	10	15	+1½	*6 13 4

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams First Pref.	5	5½	5½	3⅞	—⅛	7 14 5
do. do. 2nd Pref.	5	6	6	3⅞	—⅛	8 5 6
do. do. 5% Deb.	Stock	5	5	75½	—	6 12 5
British Electric Traction Def. Ord.	,,	—	—	500	—	... ...
do. do. 8% Pref. Ord.	,,	7	8	124½	—	6 8 6
Brazil Traction	100	5	6	222	—¼	2 14 4
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	93½xd	—1	5 6 11
do. do. Preferred	,,	6½	6½	158	+5½	8 19 1
do. do. Deferred	,,	8	8	195½	+3	*4 1 10
do. do. Deb.	,,	4½	4½	84½	+1	5 0 7
London & Sub. Trac. 5% Pref.	1	Nil	Nil	8/-	—	... ...
London United Tram Deb.	Stock	4	4	55½	—	7 4 2
Mexico Trams, 5% Bonds	—	5	5	76	—3	6 11 7
Mexico Light Common	100	Nil	Nil	67	—2	... ...
do. Pref.	100	Nil	Nil	80	—	... ...
do. 1st Bonds	—	5	5	82½	+1	6 4 0
Yorkshire (West Riding)	1	5	—	7/6	—	... ...

MANUFACTURING COMPANIES.

Babcock & Wilcox	1	13	13	3⅞	+1/8	4 1 9
British Aluminium Ord.	1	12½	10	50/-	—	4 0 0
British Elec. Transformer Pref.	1	7	7	18/3	—	7 13 6
British Insulated Ord.	1	15	15	4¼	+⅛	3 12 8
Brush Ord.	1	10	10	30/-	—	6 13 4
Callenders	1	15	15	3⅛	—	3 16 4
do. 6½% Pref.	1	6½	6½	23/-	—	5 9 5
Crompton Parkinson Pref. Ord.	1	—	—	16/6	—	... ...
Edison-Swan	4/-	10	10	10/-	—	4 0 0
do. 5% Deb.	Stock	5	5	88xd	—	5 13 6
Electric Construction	1	10	7½	25/-	—	6 0 0
Enfield Cable Pref.	1	7½	7½	23/9	—	6 6 0
English Electric	1	Nil	Nil	9/6	—	... ...
do. do. Pref.	1	6	8	12/6	—	... ...
Gen. Elec. Pref.	1	6½	6½	23/6	—6d.	5 10 8
do. Ord.	1	7½	7½	33/6	—	4 7 0
Henley	1	20	25	102/6	—	4 17 8
do. 4½% Pref.	5	4½	4½	4½	—	5 6 0
India-Rubber	1	5	Nil	13/9	—	... ...
Johnson & Phillips	1	17½	12½	51/9	—	4 15 10
Met.-Vickers Ord.	1	8	8	30/-	—	5 6 8
do. Pref.	2	8	8	2⅞	—	6 4 8
Siemens Ord.	1	7	7½	30/-	—	5 0 0
Telegraph Construction	12	10	10	24½	+1	*5 0 0

* Dividends paid free of Income Tax.
† 4% of which was Tax Free.

Conditions and Prospects in India.

Factors Affecting British Trade.

A REPORT upon the above matters has been prepared by Mr. T. M. Ainscough, C.B.E., Senior Trade Commissioner in India and Ceylon, for the Department of Overseas Trade (Stationery Office, 4s. net). The volume consists of 260 pages of valuable and interesting information, and we are only able to touch upon some of the subjects which appeal to our readers.

In a long introduction Mr. Ainscough says that, generally speaking, the trade of India during 1926-27 was fairly good in face of many adverse factors. One circumstance which will tend to stimulate trade is the fixation of the rupee at 1s. 6d.; this will remove an element of uncertainty and speculation. The outlook in the import trade is brighter than it has been for the past five years, and the engineering industries are bound to benefit from the large schemes of railway construction, harbour development, irrigation and hydro-electric enterprises, &c., which are in hand and prospect. There will be a steadily-increasing demand for plant and machinery of all kinds, and although foreign competition is keener than ever before, there is no reason why British firms should not continue to secure the preponderating share of the business if they will only give efficient service on the spot.

Trading Criticisms and Suggestions.

Mr. Ainscough devotes some space to the pointing out of British traders' weak spots. In the bazaars throughout the East low price and showy appearance count for more than quality. British manufacturers are thus at a disadvantage, and the only remedy would appear to cater for the demand in a way which will not bring the firm into disrepute. There still remains the question whether even then the British manufacturer would be able to compete successfully with the Continental maker employing cheap labour. The author considers that in many cases our marketing methods in India require very drastic overhauling in order to bring them into line with rapidly-changing conditions. In the past, the pivot of the system has been the British export merchant in London, Glasgow or elsewhere who worked through his own house in India, employed agents, or merely purchased on commission. The demand for low-priced goods led the export merchant to take up Continental goods, until the Continental manufacturer began to deal direct. Without ignoring the good work done by the export agent in the past, the time seems to have come when, in order to work the Indian market, the home shipper will be obliged to open offices in India and establish a sales organisation on the spot. In the case of heavy machinery and plant of all kinds, the manufacturers have in most cases established their own branches staffed with both commercial men and engineers. In the great majority of cases, however, British manufacturers have been content to leave the matter in the hands of their Indian agents, who, in most instances, have too many irons in the fire to give close personal attention to a particular agency.

The purchase of Government stores by the Director-General of Stores in London gave British makers a considerable advantage, which is now being diminished by the making of purchases in India. This emphasises the need for a competent local organisation, for British and foreign firms are now on an equality in tendering for Government stores, which represent a considerable trade. This transfer of purchasing power from London to India has extended to certain railways, public bodies, &c. Indian conditions approximate more closely to those of the United States than those of Great Britain, which gives the Americans a certain standing in such matters as railways, the bridging of wide rivers, irrigation, &c. Finally, the political factor has to be considered. Although the anti-British agitation has subsided, there is very little sentiment of any kind in the transaction of business in Indian commercial circles. Price is the controlling factor.

Competition in Electrical Goods.

A questionnaire was sent last year to selected import houses and representatives upon the subject of foreign competition. Inquiry was particularly directed to its nature, *i.e.*, price, credit terms, payment of agents, salesmanship, greater suitability, &c. One of the leading British importing firms in Eastern India sent a reply embodying the following information. Generally speaking, the bulk of the electrical competition is of Continental origin. The Continental prices for such items as tumbler switches, lamps, lampholders, wiring accessories, &c., are in all cases lower than British prices, but the quality is almost always undoubtedly inferior to the British. Much the same applies to motors, dynamos, &c., and it is obvious that Continental success depends on prices alone. The possible exception is electrical fittings which, while not of equal quality and finish to British products, are suitable for the work required of them. As a rule, the large German houses are prepared to give extended credit—in some cases as long as two years. At present the German firms appear to be very generous to their agents or representatives, but it is probable that the terms will be restricted when the firms become well established. Generally speaking, Continental firms are more amenable to supplying catalogues giving rupee prices, but it is not considered that foreign competitors are better served in such matters as representatives, travellers, &c. Referring again to price, the firm states that, although better prices can generally be expected for British goods, there is a limit to the margin which can be obtained. In the case of heavy electrical plant British manufacturers are frequently handicapped by being held to a very rigid and often onerous specification against which they have quoted, while foreign manufacturers can largely evade the specification owing to the difficulties of inspection. The principal point for British manufacturers is a reduction of price, consistent with the maintenance of British quality, prompt shipment, careful attention to special instructions and to packing, and continuous progress as regards improvement in design and manufacture.

Electrical Imports.

The report shows that during 1926-27 the imports of electrical apparatus, &c., were valued at Rs.2,52 lakhs, as compared with Rs.2,25 lakhs in 1925-26. Wireless apparatus to the value of 5 lakhs was imported (against 6 lakhs), the bulk of it coming from the United Kingdom. Wires and cables formed the principal item of the electrical apparatus class, amounting in value to 81 lakhs (against 77 lakhs). Electric lamps and parts were valued at 39 lakhs (against 28 lakhs), and fans at 32 lakhs (28 lakhs). Great Britain's share of the total was 1,69 lakhs (against 1,52 lakhs), although the greatest proportional increase occurred in the share of the United States—from 23 to 33 lakhs. That increase was due to larger imports of American lamps, cables and batteries. German competition is mainly in miscellaneous apparatus and fittings, wires and cables, and lamps. Holland supplies a very large proportion of the electric lamps imported.

In 1926-27 electrical machinery valued at Rs.2,30 lakhs was imported (as compared with 2,22 lakhs in 1925-26). The United Kingdom's share increased slightly—from 1,84 to 1,86 lakhs—as did those of Germany and the United States. It is stated that the demand in India for electrical machinery is likely to increase during the next few years owing to the increased utilisation of electrical energy as the country develops, and also to the important schemes of railway electrification which are in progress or prospect.

An important purchasing organisation is the Indian Stores Department, which in 1926-27 bought goods to the total value of Rs.3,98,82,245. Engineering and miscellaneous stores accounted for Rs.2,35,95,952 of the total, and among the items were electrical power generating plant and equipment, Rs.13,42,000; electrically-driven haulage equipment for Uhl River, Rs.2,56,000; electric locomotives, Rs.1,98,000; and electric fans, lamps and fittings, Rs.85,000. In consonance with the Government's desire to encourage Indian industries and local purchases the Department has compiled a register of firms in India which are able to supply and are desirous of supplying all classes of goods. The register includes 254 firms dealing in electrical equipment, the bulk of which are in Bengal and Bombay, and three dealing in wireless stores

During 1925-26 the Indian railways purchased electrical plant to the value of Rs.1.27 crores (against Rs.1.11 crores in 1924-25), practically all of which was imported. The report of the Director-General of Posts and Telegraphs for the year 1925-26 states that the value of telegraph stores purchased locally rose from Rs.12,04,000 to Rs.15,60,000, and at the same time the value of stores obtained by direct indent on the United Kingdom fell from Rs.18,51,000 to Rs.13,39,000. The local purchases included hard-drawn copper wire, glass battery jars and insulators, all of which are now manufactured in India.

The Development and Use of Electric Power.

The report embodies some notes on the Punjab hydro-electric scheme (Uhl River) by Lt.-Col. B. C. Battye, R.E. Here it is stated that large numbers of orders have been placed for constructional plant which is now arriving at the site. This plant comprises a 900-kW temporary hydro-electric installation, about 12 miles of transmission and distribution, a complete telephone system, two compressor stations with several miles of piping and a complete system of haulage and tramways. It was expected that the driving of the tunnel would be commenced in October last. The Engineering Department has been engaged in preparing detailed surveys and designs for the hydraulic works and transmission system. The designs for about 400 miles of trunk and branch transmission lines were nearing completion, and tenders were to be called for towers, cables and insulators a few months after the date of the report. A complete programme has been completed which, if adhered to, will enable the first stage of the scheme to be ready for operation by the summer of 1930.

In the Madras Presidency during 1926 preliminary reports and estimates were prepared for the Pykara, Pinjikave and Papanasam hydro-electric schemes. These were examined by the consulting engineers, and on their report it was decided

to proceed with the Pykara scheme if the demand for power justified it. Inquiry showed that a demand existed, and the scheme is to be carried out. The first stage will develop about 25,000 kW, and power will be transmitted at 110,000 V to Coimbatore, Dindigul, Trichinopoly and Madura. The principal consumers will be the South Indian Railway, which has a programme of main-line electrification from Madura to Trichinopoly and Dindigul to Podanur, and the cotton and other mills in Coimbatore and Madura. Further investigation at Papanasam is proceeding, and it appears that an initial power of 9,000 kW is available, with the possibility of doubling this later.

The Director of Public Works, Ceylon, in a report upon the hydro-electric project in that island, says that at present only the development of the first stage is contemplated. This will comprise three 6,000-kW sets, and a 50-mile transmission line in duplicate operating at 88,000 V. It has been decided to install a 6,000-kW steam station in Colombo.

In the construction of a number of important public works electricity is playing a prominent part. The power for the Lloyd Barrage & Canal Scheme is provided by a 2,350-kW Diesel-electric plant, from which energy is transmitted at 6,600 V to seven convenient points. The electrically-driven plant includes 50 8-ft. diameter mortar mills, powerful electric flood lights for night working, and a liberal number of fans. It is proposed to purchase plant for a 3,000-kW power station in connection with the Cauvery Falls project, together with other plant valued at Rs.50 lakhs. A note on the Calcutta Chord Railway project and the Bally Bridge gives very full details of the electrical equipment which is being employed. The sinking of the foundations for the bridge piers is being carried out by dredgers operated by 15-ton electric cranes. On the west bank of the Hooghly power is taken at 10,000 V from the main line from the East Indian Railway power house. The transformers and low-pressure plant are of the English Electric Co.'s manufacture. The power on the east bank is provided by the Calcutta Electric Supply Corporation. The sub-station is practically identical with that on the west bank. A feature of the sub-stations is a 90-kVA condenser in each (made by the British Insulated Cables, Ltd.), designed to maintain the power factor at about 0.9.

Radio-Telegraphy and Broadcasting.

Mention is made of the opening of the "beam" service between this country and India last July. The extension of the system for communication with other countries is contemplated when the present service is satisfactorily established. In view of the success attained by the use of short waves for telephonic purposes, the Indian Radio Telegraph Co., Ltd., also contemplates using the "beam" for a service of this nature, in addition to the ordinary telegraphic traffic. The matter has been discussed with the Indian Government. The company has continued to develop point-to-point radio communication within the country, and has also proceeded with the public address system. Numerous avenues for the application of radio-telegraphy are available, and considerable advances are anticipated. The Bombay broadcasting station was opened in July and the Calcutta station a little later. At the end of April last, 95 dealers had become members of the Indian Broadcasting Co., Ltd., in order to import apparatus. On their imports the company receives the sum of 10 per cent. Although hitherto the imports have been on a very small scale, they are expected to expand considerably when the service is properly established.

The Foreign Electrical Trade of Denmark.

Imports and Exports during 1925 and 1926 Compared.

THE following table shows Denmark's imports and exports of electrical machinery and apparatus in 1925 and 1926, indicating the principal countries of origin and destination. Notes of increases and decreases are also given. In spite of a fairly well developed export trade in electrical goods Denmark is still a considerable importer. Indeed, in 1926, the general tendency was for exports to decline and imports to increase. Even after allowing for the reduced level of prices, substantial reductions are revealed between 1925 and 1926 in shipments of insulated wire and cables, motors, dynamos and other electrical machinery, the falling off amounting to at least 50 per cent. Less installation material also was exported. At the same time on the import side there was a still more marked decline in cables but, on the other hand, a big advance in wireless material, while other lines were quite well maintained.

Imports.

	1925. Kr. (thous.)	1926. Kr. (thous.)	Inc. or dec. Kr. (thous.)
Electric cables—			
Total	1,506	286	−1,220
From Germany	1,148	101	−1,047
,, Holland	347	53	− 294
,, Switzerland	(a)	112	—
Insulated wire—			
Total	1,904	1,023	− 881
From Germany	1,124	562	− 562
,, Sweden	115	58	− 57
,, Holland	346	132	− 214
,, Belgium	71	110	+ 39
,, United Kingdom	65	71	+ 6
,, United States	112	73	− 39
Accumulators and plates—			
Total	1,135	1,493	+ 358
From United States	322	202	− 120
,, Germany	682	1,069	+ 387
,, United Kingdom	94	149	+ 55
Installation material (switches, lamp-holders, fuses, &c.)—			
Total	1,518	1,676	+ 158
From Germany	1,231	1,208	− 23
,, United Kingdom	130	127	− 3
,, Sweden	55	80	+ 25
,, United States	46	43	− 3
Dynamo lighting sets, ignition magnetos, &c.—			
Total	595	752	+ 157
From Germany	386	364	− 22
,, United States	193	331	+ 138
Batteries and cells—			
Total	870	868	− 2
From Germany	538	518	− 20
,, United States	263	285	+ 22
,, United Kingdom	38	27	− 11
Radio apparatus—			
Total	3,300	6,439	+3,139
From Germany	1,600	3,512	+1,912
,, United Kingdom	722	711	− 11
,, Holland	473	883	+ 410
Electrical machinery and apparatus not elsewhere specified—			
Total	497	536	+ 39
From Germany	297	378	+ 81
,, United Kingdom	49	45	− 4
,, Sweden	19	—	− 19
,, United States	94	50	− 44
Dynamos, generators, motors, transformers, stators, armatures, rotors, &c.—			
Total	2,669	2,614	− 55
From Germany	1,359	1,030	− 329
,, United Kingdom	518	581	+ 63
,, Sweden	146	359	+ 213
,, United States	463	297	− 166
Telephone apparatus—			
Total	125	73	− 52
From Sweden	32	26	− 6
,, Germany	66	24	− 42
,, United Kingdom	9	10	+ 1
Electrical measuring instruments—			
Total	539	399	− 140
From Germany	491	319	− 172
Other electrical instruments—			
Total (mainly from Germany)	49	60	+ 11
Vacuum cleaners—			
Total	1,360	1,673	+ 313
From Sweden	1,159	1,365	+ 206

Exports.

	1925. Kr. (thous.)	1926. Kr. (thous.)	Inc. or dec. Kr. (thous.)
Electric cables—			
Total	1,051	512	− 539
To British South Africa	312	33	− 279
,, Poland	270	46	− 224
,, Norway	120	34	− 86
,, Sweden	141	165	+ 24
Motors and dynamos—			
Total	2,737	1,858	− 879
To Sweden	507	423	− 84
,, Great Britain	367	227	− 140
,, Norway	277	80	− 197
,, France	247	135	− 112
,, Italy	237	78	− 159
,, Argentina	130	165	+ 35
,, China	188	186	− 2
,, Asia Minor and Syria	110	*	—
,, Spain	67	48	− 19

	1925. Kr. (thous.)	1926. Kr. (thous.)	Inc. or dec. Kr. (thous.)
Insulated wire—			
Total	297	88	– 209
To Holland	105	*	—
„ Belgium	67	35	– 32
Telephone apparatus—			
Total	49	30	– 19
Electrical measuring instruments—			
Total	61	36	– 25
To China	33	—	– 33
„ Great Britain	10	6	– 4
Installation material (switches, lampholders, &c.)—			
Total	900	658	– 242
To Sweden	322	272	– 50
„ Belgium	128	67	– 61
„ Great Britain	64	52	– 12
„ China	65	21	– 44
„ Norway	70	57	– 13
Batteries and cells (including flash-lamps)—			
Total	6,389	5,954	– 435
To Great Britain	1,971	1,681	– 290
„ Norway	529	456	– 73
„ Sweden	1,097	1,375	+ 278
„ Finland	402	509	+ 107
„ Holland	176	192	+ 16
„ Belgium	357	159	– 198
„ Spain	535	381	– 154
„ Argentina	143	112	– 31
„ British South Africa ...	166	215	+ 49
„ Australia	519	402	– 117
Electrical machinery and apparatus, not elsewhere specified—			
Total	643	340	– 303
To Great Britain	98	41	– 57
„ Sweden	94	43	– 51
„ Holland	97	65	– 32
„ China	89	13	– 76
„ Japan	57	21	– 36
„ Finland	49	40	– 9
„ Russia	21	12	– 9
Wireless apparatus—			
Total	510	122	– 388
To Sweden	218	30	– 188
„ Greenland	118	8	– 110
„ Iceland	59	26	– 33
Electrical porcelain goods—			
Total	433	491	+ 58
To Spain	114	84	– 30
„ Belgium	94	56	– 38
„ Russia	69	120	+ 51
„ Great Britain	62	34	– 28
„ Switzerland	—	136	+ 136

* Not shown.

Auto-Transformer Starters.

An Improved Range of Starting Equipment recently introduced by the General Electric Co., Ltd.

THE General Electric Co., Ltd., has recently considerably amended the design of its range of auto-transformer starters, embodying some new constructional features, with a view to enabling a high degree of operating efficiency to be obtained. These starters are made in seven different types, with horse-power ratings varying from 5 to 240, suitable for pressures, according to the h.p., of from 220 to 3,000 V, 3-phase.

In all cases the auto-transformer is oil immersed, and it is an important feature that (with the exception of type 1A) the oil-immersed switches are in an entirely separate compartment from the transformers, thus ensuring that no carbonised oil from the switches can be deposited on the transformer below where it would be likely to impair the insulation.

The starting switches are of the drum type and control both the primary and secondary sides of the transformers; in all cases they are operated by a lever. The rotating drum is operated by a handle at the side of the starter case and carries the moving contacts which make and break circuit on the adjacent fixed contacts. These semicircular fixed contacts are secured to brackets by means of phosphor-bronze strips and a pressure is applied to the centre of the contacts by means of flat springs.

Adjustment is extremely simple and effective and any necessary renewals can be quickly and easily carried out, each part being clearly stamped for identification purposes. The contact fingers are arranged to be self-aligning with the drum, and there is no possibility of any finger being pushed back too far and thereby causing an open circuit.

Tappings are provided on the transformers for 40, 50, 60, or 70 per cent. of the line pressure, and are brought to a clearly marked terminal board which is easily accessible. Fig. 1 shows a starter unit with the switchgear exposed.

A sequence device is fitted to all the starters to prevent the operator switching the starter direct to the "running" position. In the smaller types the operating handle is first moved downwards to the "starting" position, and when the motor is speeded up the arm is quickly moved upwards through

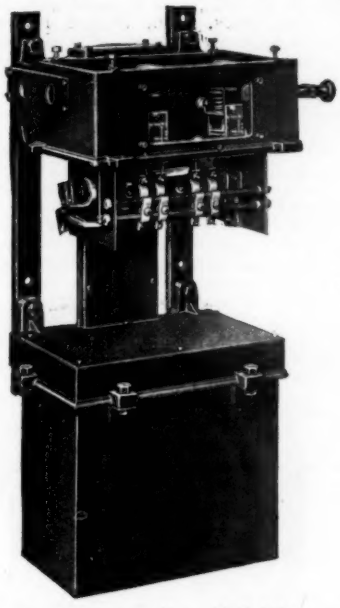


Fig. 1.—Auto-Transformer Unit with Switchgear exposed.

90 deg. to the "running" position, in which it is retained by a catch on which the no-volt plunger operates. In the larger types this arrangement is somewhat different, and a special device is employed to ensure that the operator makes a pause at the "starting" position before passing to the "running" point. If the handle is released before reaching "full on" the starter automatically returns to the "off" position. When the starter is "off" the motor is entirely disconnected from the line.

All the l.p. apparatus can be fitted with any combination of trips up to 3-overload releases and one no-volt release. In the

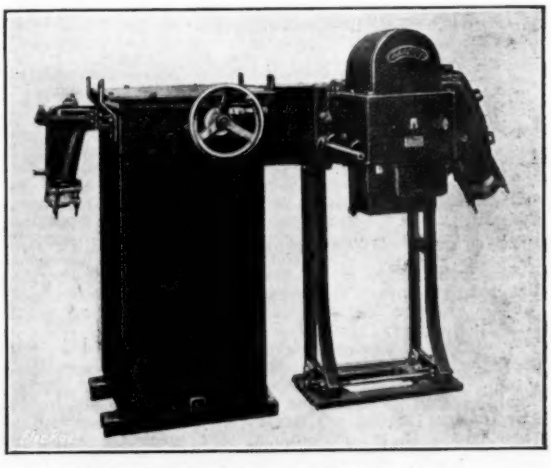


Fig. 2.—Combined Starter and Circuit Breaker.

case of the high-pressure equipment, requiring automatic features, it is necessary to install, in addition to the starting switch, a pedestal-mounted oil circuit breaker embodying these features and situated adjacent to the auto-transformer, as shown in fig. 2. Ammeters and cable boxes can be fitted to these starters as required, and the frames of the starters can be manufactured with flame-proof features.

In the case of the h.p. starters, an electrical inter-lock is provided between the oil circuit breaker and the auto-transformer starting switch.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this Section.

A Continuity Testing Set.

The need for a simple and accurate means of measuring the resistance of earthing conductors was strongly emphasised in the annual report of H.M. Chief Inspector of Factories and Workshops for 1926, and to meet this need SALFORD ELECTRICAL INSTRUMENTS, LTD., Magnet House, Kingsway, W.C.2, a branch of the General Electric Co., Ltd., has developed a continuity testing set, fig. 1, which is designed to work with an appreciable current from an accumulator. When the instrument is indicating a resistance of one ohm a current of 0.75 A is flowing through the earthing conductor. The testing set is entirely self-contained, and by its use it is possible to measure the resistance between points separated by a distance of one hundred yards, no additional leads being required. Included in the set is a moving-coil or moving-iron instrument scaled to read in ohms direct. A variable resistance is connected in series with the movement, and enables the zero ohm reading to be corrected prior to making a test. In the lower portion of the apparatus is housed a drum carrying 97 yards of heavily insulated cable. To indicate when contact at the far end has been made, a bell mounted within the set is made to ring. The complete set is portable, weighing about thirty pounds, and is fitted with a leather carrying strap.

Fig. 1.—Continuity Testing Set.

Car-Washing Equipment.

The "Automixspray," a device for facilitating the work of cleaning such vehicles as tramcars, has been developed by Mr. A. C. L. DUNN, Westwood House, Woodlands Road, Darlington, and is marketed by Messrs. GEORGE DENHAM AND Co., Darlington. The apparatus fits upon the end of an ordinary hose-pipe fitting, and utilises the kinetic energy of the hose jet, in part, to form a suction head, which is available at the hose for the admixture of fluid washes and polishes with hose water. These washes, when mixed, are foamed at the nozzle of the instrument and thence ejected upon the bodywork to be cleaned. Polishes are ejected in a similar manner, and also strong solvents, when required. These do their work upon the coach, and are finally removed by clean water from the jet. After this treatment the surface will be found, it is claimed, to dry perfectly clean and polished. One operator only is required.

An Electric Invalid Carriage.

The ARGSON ENGINEERING CO., LTD., of Beaufort Works, East Twickenham, has recently brought out a single-seat four-wheel electric invalid vehicle, fig. 2, which is intended to replace the Argson electric three-wheeler. The new machine is a miniature electric car with a large and comfortably upholstered seat of the armchair type; the footboard is only 8 in. above the ground, and a side door is provided so as to enable the vehicle to be readily mounted by the most infirm rider. The driving motor is of 1 h.p., runs on ball bearings, and is arranged vertically over the differential gear. The drive is through a worm and worm wheel to a single reduction gear and the back-axle. Provision is made for sliding the reduction gear out of mesh to enable the motor to be tested or the carriage to be manœuvred without the use of the motor. Current is supplied by a 24-V battery of tractor-type Exide ironclad cells, having a capacity of 110 ampere-hours at a 10-hour discharge rate. The battery is enclosed in an all-metal acid-proof case which supports the seat, and is so arranged that it can be tilted forward for ready inspection of the battery.

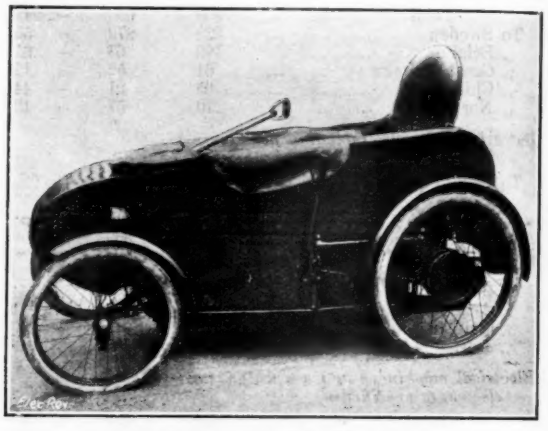


Fig. 2.—Electric Invalid Vehicle.

A bus-bar at the front of the box renders the connections and charging plug readily accessible. The makers guarantee a minimum run of 60 miles on one battery charge on normal roads and a speed of 9 m.p.h., or slightly more, on the level. Steering is controlled by a tiller lever on which the controller is mounted. Provision is made for locking the controller to prevent interference with the vehicle when left unattended.

A Switch, Fuse and Plug Combination.

Intended for controlling such portable electrical apparatus as drilling machines and saw benches, a range of weatherproof combined switch, fuse and plug boxes has been introduced by Messrs. A. REYROLLE & Co., LTD., Hebburn-on-Tyne. Fig. 3 shows an example. The switches are suitable for frequent operation on 660-V circuits, and are capable of carrying 25 per cent. overloads. A quick double-break motion is incorporated on each pole. The fuses are of the ventilated porcelain-handle type, and are fitted with self-aligning contacts. The plugs may be either 30 or 60 A, and are provided with separate earthing pins. Each plug is fitted with a screwed coupling-ring, so that a weatherproof joint can be made.

Fig. 3.—A Switch-Fuse-Plug Unit.

Radio Rotating-Beacon Transmitters.

A theoretical discussion of possible aerial arrangements; their application to marine navigation and aircraft for direction-finding purposes.

(Extracts from Papers read before the WIRELESS SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE investigations upon which two of the papers treating of various aspects of the above-named subject are based were carried out as part of the programme of the Radio Research Board (Department of Scientific and Industrial Research), whilst the third outlines a method developed by the Air Ministry at the instrument design establishment at Biggin Hill, Kent, and later at the Royal Aircraft Establishment, Farnborough, Hampshire. The following extracts from the papers will serve to indicate their scope:—

Transmission Method.

As an alternative to the use of a radio direction-finder for navigation purposes, the rotating beacon system of directional transmission has been developed to a high degree in this country by the Royal Air Force. It makes use of a vertical closed loop rotating about a vertical axis at a uniform speed of 1 revolution per minute; except for the emission of two special signals, radiation is constant, so that a steady dash is received during the rotation of the coil; radiation from the coil is proportional to the cosine of the angle between the plane of the coil and the direction of transmission, and the polar diagram is thus the familiar figure-of-eight. At a fixed receiving station, therefore, the signal intensity varies from a maximum when the plane of the coil is in line with the receiver, to a minimum (or zero) when the plane of the coil is at right angles to the direction of the receiver. Bearings are obtainable with the aid of a simple timing arrangement which operates as follows.

When the plane of the coil is perpendicular to the geographical meridian a characteristic signal is emitted by the beacon which may be termed the N point. An observer at a distant receiving station, upon hearing this signal, starts a chronograph. As the beacon revolves the intensity of the received signal varies and will ultimately pass through a minimum or zero value, at which instant it is known that the plane of the transmitting loop is at right angles to the great circle joining transmitter and receiver. If the reading of the chronograph is observed at this instant of minimum signal intensity, it is evident that the bearing of the transmitter from the receiver can be obtained by a simple calculation. To provide for the case in which the observer is due north or south of the beacon, when the N signal would probably be inaudible, another characteristic signal is emitted after a 90 deg. rotation to the corresponding point. Bearings observed from this signal as a starting point are evidently subject to a correction of 90 deg. It is to be noted that since the radiation from the coil is symmetrical about its plane, a second minimum will be obtained after a rotation of 180 deg. from the first. With the beacon making 1 revolution per minute, therefore, a line bearing is obtainable every half-minute. To fix the position of a receiving station, it is necessary to obtain line bearings in this manner from two or more beacons.

Application to Marine Navigation.

By R. L. SMITH-ROSE, D.Sc., Ph.D., and S. R. CHAPMAN, M.Sc., A.M.I.E.E.

With the object of examining the rotating-loop beacon's performance from the standpoint of its utility for shipping and marine navigation, an experimental transmitter was set up by the Air Ministry at Fort Monckton, near Gosport, in July, 1926, and loaned to the Radio Research Board for the purpose of conducting the experiments described in the following paper; throughout the beacon was operated on its normal wave-length of 525 metres.

A calibration was carried out at fixed points in various directions around the beacon, and at distances from it varying from 2 to 60 miles, which showed that the bearings observed are subject to permanent deviation due to land effects, the magnitude varying with the direction of transmission; over the small open-sea sector available from Fort Monckton it is limited in value to 1 or 2 deg.

A series of tests, carried out in various cross-channel ships between England, France, and the Channel Islands, showed that for clear open-sea ranges up to 50 or 60 miles the observed wireless bearings agreed within an extreme limit of 5 deg. with bearings estimated by other navigational methods; and in about 70 per cent. of the cases the agreement was within 2 deg. In subsequent experiments it was shown that from ships at anchor at distances of 90 to 100 miles the wireless bearings observed in the daytime agreed within 4 deg. of the bearing calculated from the ship's position. At distances exceeding 60 miles, however, wireless bearings from the rotating beacon were subject to night effects similar to those experienced in wireless direction-finding. The errors resulting from these effects were not very serious until the range of transmission exceeded 90 miles over sea, beyond which the errors of individual bearings amounted to 18 deg. Even in these circumstances, however, a moderately accurate bearing can be obtained by taking the average of a series of consecutive readings over an interval or 10 or 15 minutes. The minimum range at which night errors were encountered was considerably reduced when the transmission was entirely, or partly, over land. Within the range of reliable working, the accuracy of the observed bearings was sensibly the same whether c.w. or i.c.w. transmission was employed at the beacon.

Taking the somewhat conservative figure of 50 miles as the reliable working range of the beacon for accurate bearings by both day and night, the present beacon gives adequate signal strength to a typical ship's receiver for observation at this range, except in the most unfavourable conditions of heavy interference.

In the course of the investigations a comparison was made between the bearings observed on the rotating beacon and those obtainable with a direction-finder used in the ordnary manner. When used in fixed positions on land, the direction-finder gives somewhat superior accuracy, as it is not easy to obtain bearings on the rotating beacon to an accuracy of less than 2 deg., whereas a good land direction-finding station should give bearings reliable to 1 deg. As is well known, however, the land direction-finding station is subject to errors due to local conditions which necessitate its frequent calibration, but the observed bearings from the rotating beacon have been shown to be largely immune from conditions local to the receiver. When the wireless bearings are taken on board a ship at sea, however, the case is somewhat different. The direction-finding bearing is taken relative to the direction of the ship's head, and its accuracy depends upon the steadiness of the ship and also upon the accuracy with which the ship's head is given by the compass reading at any desired instant. The bearing obtained by the rotating beacon is entirely free from this limitation, and its accuracy is practically the same whether the ship is at sea, in motion, or at anchor, or in dock. Furthermore, no correction corresponding to the quadrantal error associated with the ship's direction-finder is necessary. The limitation of range of accurate bearings due to night effect has been shown, both theoretically and experimentally, to affect both systems to the same degree.

Application to Aircraft.

By T. H. GILL and N. F. S. HECHT, M.I.E.E.

This paper relates to this method of transmission as it has been developed for the elimination of direction-finding equipment and the reduction of operational difficulties in aircraft. Bearings can be determined with an accuracy at least equal to that of any other wireless system of direction-finding; at ranges up to 200 miles the accuracy is quite sufficient for aerial navigation.

Although it is premature to assume that the method is free from night variations, at any rate, so far as aircraft reception is concerned, up to the present no variations of direction have been noticed, although the observer has particularly looked out for them. A point which has not been overlooked is the possibility of confusion which may arise when using continuous-wave transmission: there are so many c.w. carrier waves in use that delay in obtaining bearings may arise if an observer tunes in one of these and waits for the minimum which never comes. This would not normally occur, as each beacon would send out its call sign at regular intervals and would also send the N and E indications, but in order to prevent any difficulty on this score a distinctive characteristic could be given to the radiation, such as breaking up the continuous signal into high-speed dots.

Aerial Arrangements.

By R. L. SMITH-ROSE, D.Sc., Ph.D., A.M.I.E.E.

The arrangements of aerial for a rotating-beacon transmitter are discussed from the theoretical point of view.

In the case of the single-coil system it is shown that under night conditions, when wireless waves can be deflected from the upper ionised layer, the signal minimum as observed at the receiver can occur at such times during the rotation of the coil as to indicate an error in the observed bearing ranging up to 80 deg., which error is of the same order as that observed on an ordinary direction-finder under similar conditions.

The treatment of the arrangement of two co-planar spaced coils, as sometimes employed for directional reception, shows that, while the time of occurrence of the minimum giving the correct observed bearing remains unaltered during all conditions of night effect and downcoming waves, other secondary minima may be obtained under these conditions, the observed bearings on which may be in error by the same amounts as those obtainable with the single-coil transmitter. As the observer at the receiver will, in general, be unable to distinguish between main and secondary minima, the double-

coil system would appear to possess nearly the same liability to error as the single-coil system. The possibility of the two minima occurring close together will also detract from the accuracy of observation of the main minimum, even supposing it could be distinguished from the other.

The third case considered is that proposed by Mr. C. E. Horton, *viz.*, the use of the Adcock aerial system as a rotating transmitter; it is shown that a signal minimum is produced when the plane containing the pair of vertical aerials, or their equivalent in space, is perpendicular to the direction of the receiver. This minimum remains unaltered in the presence of downcoming waves at night and, as no secondary minima occur, it appears that this system will give correct bearings at all times when the signal is strong enough for observation. In searching for a type of rotating-beacon transmitter upon which the observed bearings are independent of night errors, it would appear that the Adcock arrangement, which may be regarded simply as a pair of spaced vertical aerials wherein the currents flow in opposite phase, is the most hopeful as a means of eliminating night errors.

A New Testing Set.

The new "Universal" instrument of the International Electric Co., Ltd., is claimed to meet all the requirements of the testing engineer.

A LONG-FELT need of the electricity supply or distribution undertaking is an apparatus of a simple nature and in portable form which will indicate approximately the location of a fault, at the same time not being too sensitive to the conditions on the line generally. Further, the apparatus should be suitable for placing in the hands of the mains foreman, or even the jointer.

The claims made for the outfit which has been evolved by the International Electric Co., Ltd., and some tests witnessed on l.c. wiring under indoor conditions, rather suggest that the want is near being fulfilled; at any rate, the set is worthy of the mains engineer's consideration. It will deal with high-resistance faults of up to 400,000 ohms, while, in conjunction with an amplifier, it is claimed, the exacting demands of the P.O. engineering department can be approached. The apparatus can also be used for the ordinary measurement, against standards, of resistance, capacity, and induction.

The "Universal" test set and cable-fault finder, fig. 1, is built in a solidly constructed oak box capable of withstanding

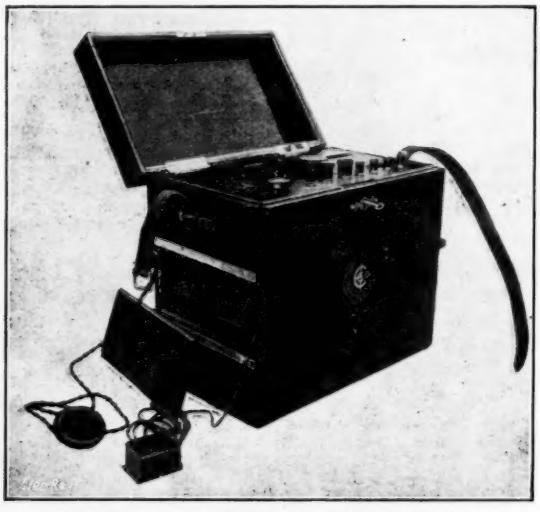


Fig. 1.—The "Universal" Testing Set.

transport; carrying straps are provided. Sliding lids are fitted in the side and bottom of the box, the former covering a compartment for the apparatus required for a.c. tests, *i.e.*, buzzer, telephone and leads, key and terminal panel, handles, and so on; the latter covers the battery chamber.

The top lid of the box is arranged for easy removal to allow convenient handling of the apparatus in restricted places, such as man holes, where elbow room is rather scarce. The top panel is equipped with the necessary keys, switches, and terminals required for the different tests and measurements, the designations for the switches, terminals and registers being engraved in accordance with the booklet of instruction supplied with every apparatus.

The principle of the instrument is, of course, that of the Wheatstone bridge. The mechanism, fig. 2, consists of a slide wire of considerable length built up spirally on a specially constructed drum. Two sliding contacts are attached to rotating arms and can be advanced or receded along the spiral. One of the contacts is used for giving the necessary balance on the galvanometer (or telephone), and is geared to a register which indicates "distance of fault"; the other contact is used for fixing the total length of the slide wire, in proportion to the length of the cable (or resistance, capacity or inductance), and is geared to a register showing "length of cable." Particular care has been taken to ensure constant pressure and resistance at the sliding connections, and the slide wire is, it is claimed, thoroughly tested point by point for uniformity of resistance and cross-section throughout its length before being inserted in the instrument. The ends of the "bridge" are led out direct to the panel by means of short lengths of heavy cable, the effect of which on the results of tests is negligible. The rotating contact arms are geared directly to their respec-

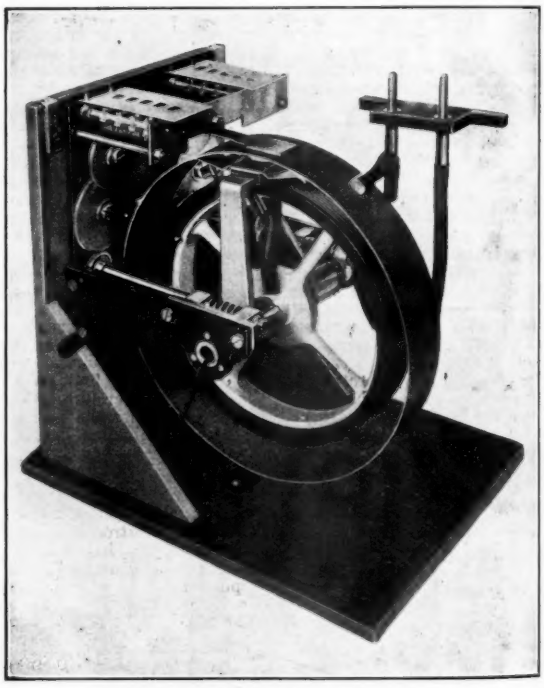


Fig. 2.—The "Bridge" Unit.

tive registers, strong solid wheels designed to give long service without appreciable wear and eliminate slipping or backlash being employed. The registers are set to give direct readings if desired, and are subjected to severe tests before and after being incorporated in the apparatus.

The movement of the mechanism is effected by operating neatly designed handles, which are packed away in the side compartment of the box when not in use.

A special feature of the outfit is the galvanometer. This is of the highly sensitive Unipivot, uni-parallax type, and has the usual zero adjustment and locking device. It is fitted in a separate compartment in the box, and readings are taken through a windowed aperture on the top panel. Besides the ordinary deflection scale the galvanometer has a direct resistance scale for use in connection with insulation resistance tests. A dry battery is provided in the compartment of the box reserved for that purpose.

Test connecting leads for use with the instrument when the cable ends cannot be directly employed, and special cable lugs for connecting up the cable ends, are included. The weight of the instrument fully equipped is 28 lb.

Interconnected Supply Systems.

The Control of Power Factor and Voltage in Linked Systems without Boosters.

By Prof. O. R. RANDALL.

(Abstract of paper read before the SOUTH AFRICAN INSTITUTE OF ELECTRICAL ENGINEERS.)

WHEN interconnectors are used to link up systems the factors which determine the transmission of power along the line become of first importance. It is not obvious which side will function as primary. The fact that one side has a higher voltage than the other (with one to one ratio) is not sufficient to cause it to do so. For a given interconnector there are two conditions involved (the voltages on the two sides and the relative positions of the voltage vectors) which make the problem of the interconnector a very difficult one to study. Various combinations of the two variable quantities, voltage and phase displacement, can give the same result, and in order to fix the condition which will hold for a particular case another set of factors has to be considered, namely, that relating to the machines at the ends of the line.

An alternator and an interconnector were connected in parallel to a constant load greater than the alternator output. The input to the motor which drove the alternator was maintained constant and the excitation of the alternator was varied.

The interconnector voltage at the input end was constant, and as the alternator field was varied the interconnector quantities were observed.

The function of the interconnector was to supply part of the power needed by the consumer load. It will be accurate

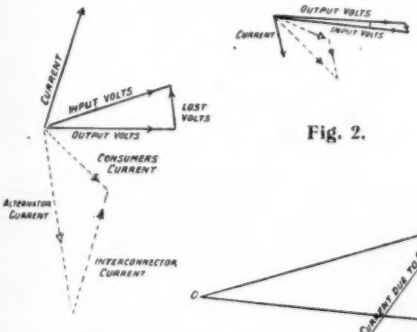


Fig. 1.

Fig. 2.

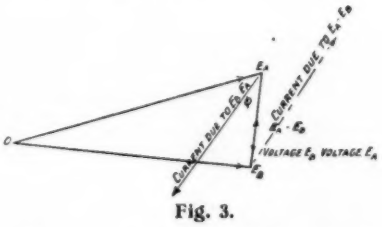


Fig. 3.

enough to consider the consumer current as constant, so that the sum of the interconnector and alternator currents must be constant.

Fig. 1 shows the conditions with the alternator very much over-excited (about 75 per cent.). The transformer current is leading and has a large wattless component which has to be balanced by an equal lagging component from the alternator.

The dotted lines represent the three currents, consumers, generator and interconnector, and the full lines refer to the interconnector quantities.

This illustrates the very bad conditions introduced at the generating station by a leading current in the interconnector. While the wattless current needed by the consumer load is 32 A, the wattless component supplied by the generator is 98 A.

When the alternator excitation had been reduced to about one and a half times its normal value, the alternator wattless current was about 71 A. This improvement was purchased at the expense of about three-quarters of one per cent. of the terminal voltage at the generator.

In fig. 2 the conditions for about normal excitation are shown. The interconnector current has now become a lagging one, with the result that the alternator conditions are very much improved, since the interconnector supplies a great deal of the wattless current needed by the consumers' load. The result on the terminal voltage at the common point is a drop of about 4.2 per cent.

To examine the conditions which determine which side of an interconnector functions as primary, in fig. 3 let OE_a be the voltage applied to one side of the transformer, and OE_b the voltage applied to the other side. The alternator rotor A will be slightly in advance of the alternator rotor B.

If the side B is the primary, the loss in the transformer will be the applied voltage, OE_b minus the applied voltage OE_a. This is the vector $E_a E_b$. The current will lag behind this voltage by the internal phase angle of the interconnector, and is seen not to have a component in phase with the supposed primary voltage OE_b, and, therefore, the side B is not the primary. If the side A is assumed to be the primary, the impedance voltage is the line joining the ends of the vectors OE_a and OE_b, but is drawn upwards, since it is now OE_a minus OE_b. On drawing the current vector, we see it has a component in phase with the supposed primary voltage, and so the side A is primary. We cannot speak of a side ceasing to function as a primary or secondary, because, for a certain range of conditions, the interconnector will float and absorb power from both supplies, and we cannot say which side is primary in these circumstances.

This floating condition becomes important when it is accompanied by large wattless currents.

To show the pernicious effect of this circulating current, the results of certain tests have been plotted, and in fig. 4 the curves show the power supplied by the alternators to the interconnector and also the power delivered at the remote end of the line, where the voltage was constant. The vertical distances between the two curves gives the loss in the interconnector. The curves show that with an over-excited generator, the loss is much greater than the input from the station considered. This condition necessitates a supply of power from the remote station also, so that instead of being helped this station is also carrying an interconnector load.

As the excitation is diminished the conditions improve, until at the top of the curves the interconnector is functioning very well.

If the load delivered by the interconnector be constant the useful load will decrease as the losses of the receiving set increase. Although the line delivers the same power at various power factors, different proportions of it will be available, namely, the fixed supply minus the varying losses in the receiving system.

A line supplying power to synchronous motors, the motors being at the station under consideration, is not usually spoken

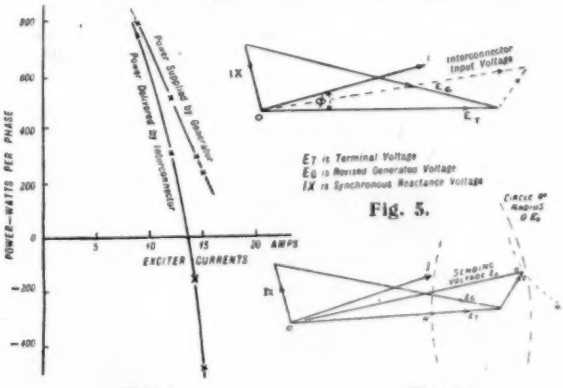


Fig. 4.

Fig. 5.

Fig. 6.

of as an interconnector, but the problem is very similar to that of two generating stations joined by a link, and it has some importance in practice.

It will be assumed that the effects of armature reaction and reactance can be represented by a single vector, and the armature resistance will be neglected. The diagrams for the motor will be similar to the full lines of fig. 5 which shows a machine operating with a leading current. The input power per phase is $E_s I \cos \phi$. The armature ampere turns are responsible for the voltage I X. If this vector diagram is combined with that for the interconnector, the main conditions being satisfied, we add the dotted lines of fig. 5.

It will be necessary to decide how the power condition is to be fixed.

The condition which was assumed to hold when the interconnector was being considered will now be changed, and instead of the interconnector being supposed to deliver constant power, the synchronous motor output will be assumed constant. This means that the motor input and, thus, the interconnector output will vary with the losses of the synchronous machine and with its exciter load.

With the stated power condition and with constant sending voltage, there are generally two definite values of motor excitation for every value of motor terminal voltage. Whether both of these excitations are realisable in a particular system depends largely on the internal phase angle of the interconnector.

For a given value of terminal voltage E there may be a limiting value of delivered power, no matter what the motor excitation may be.

In fig. 6, let E be the chosen terminal voltage and let IN, I′N′, I″N″ be various power curves, each one defining the ends of the current vectors for a certain motor output. Let *e m*, *e′m′*, *e″m″*, &c., be the corresponding curves defining the ends of the impedance voltage vectors. It is evident that there may be some such curve which is a tangent to the circle with E_0 as radius, and the curve IN which corresponds to this curve *e m* will define the greatest series of values of motor input, and

thus the greatest constant motor output, for which the terminal voltage E_t can be kept at chosen value. Since the curve *e m* and the circle will practically coincide over a comparatively long length, it follows that when the maximum power is delivered, E_t will be fairly constant in spite of a considerable variation of motor excitation. The interconnector sending pressure was 73 volts to neutral and the load on the synchronous motor was 1,960 W per phase.

The effect of increasing the phase angle is to turn the curves *e m* anti-clockwise, so that they are then more likely to cut the circle.

With a fixed motor output and a variable motor excitation there may be a maximum value of E which cannot be exceeded in spite of changes in the motor excitation.

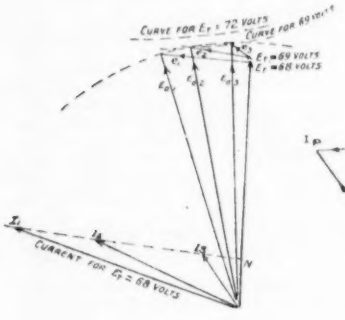


Fig. 7.

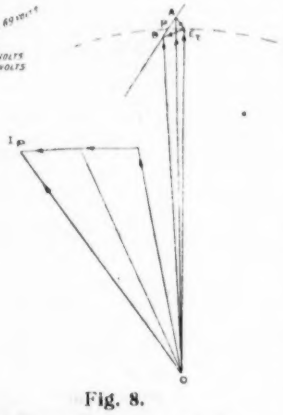


Fig. 8.

A synchronous motor fed from an interconnector containing transformers was made to supply a constant load. The excitation was varied and the variation of the common voltage where the interconnector was linked to the motor was observed.

The vector diagrams for three excitations are shown in fig. 7. These are drawn from the test results. The curve *e m* for E_t = 69 volts is approximately tangent to the circle whose radius corresponds to the sending voltage, 73 volts. This value for E_t, 69 volts, was the highest recorded during the test.

The curve for E = 72 volts is also shown, and the fact that this does not cut the circle agrees with the test results, since no pressure higher than 69 volts could be obtained.

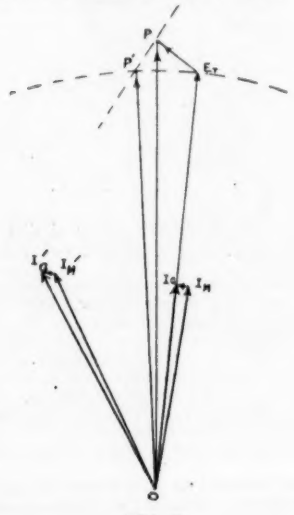


Fig. 9.

In fig. 8 two sets of voltage vectors, one for a 40-deg. lagging motor current and one for a 40-deg. leading motor current, are shown. As the locus of the end of the impedance voltage vector is now a straight line, the line passing through A and B is the locus for the load assumed. To examine the conditions with equal voltages at the two ends of the line, the circle, whose radius is 50,800 V, has been drawn. This cuts the locus through A and B at P, and the line PE_T is the necessary impedance loss. This gives the generator current OI_p. From this we see that to maintain equal voltages about 7 A of leading wattless current must be supplied in addition to the charging current, the kVA of the line being 6,150 for 5,000 kW.

If it is desired to maintain unity power factor at the generator, for the small load which the line is conveying the rise in voltage at the generator end must be about 1,200 per phase, or 2.4 per cent.

To find the voltage conditions for unity power factor at the generators and for equal voltages, we shall assume that the voltage at the motor load is 88,000 across the lines. The charging current will be treated as though it is distributed in four condensers, each absorbing one quarter of the total charging current. The volt drop between the generating station and the chosen point half-way along the line is due to the whole load current and three-quarters of the charging current over a distance of 40 miles of line. The conditions will be as follows: Motor power component of load current, 198 A per line; motor voltage to neutral, 50,800; line resistance for 40 miles, 15 ohms; reactance, 28 ohms; impedance, 32 ohms; total charging current, 17 A; and charging current between generator and motor helping to produce voltage loss, 12.7 A. The vector diagram is shown in fig. 9. For unity power factor at the generators the current vectors are I_m and I_p, and the impedance voltage is E P. The rise of voltage at the generator is about 5,700 per phase. For equal voltages the currents are I′ and I′, and the impedance voltage is $E_t P'$. For this condition, the generator must supply about 115 A of wattless current, besides magnetising current. The line defining the end of the interconnector lost voltage is such that it will cut the circle defining the sending voltage once, but not twice, for all reasonable values of E_t and delivered power. This means that increases of motor excitation result in increases in the motor terminal voltage, and that the limit is imposed by the very bad power factor conditions which accompany these increases.

In most of the tests the alternator was driven by a motor whose input was kept constant for a complete test. The output of the alternator was not constant, because, as its excitation was changed, it absorbed varying amounts of power due to its changing exciter load and its changing I^2R loss.

The results show that with an incorrect value of excitation the losses in the alternator and the exciter rise to such a value that the interconnector load is considerably increased to supply these losses. Since the interconnector current is correspondingly increased and the phase angle in the interconnector is made worse, the load imposed on the sending station by the sum of these losses is much greater than is necessary. The following figures have been worked out from the test results. For phase angles at the generator of 0, 54, 76, and 88 deg., the useful power delivered by the generator is 2,030, 1,780, 1,400, and 560 W per phase, respectively, and the power supplied by the remote station is 1,300, 1,280, 2,090, and 6,490 W per phase, respectively. The figures are plotted in fig. 10.

The constant consumers' load was 3,000 W per phase.

The results of tests for demonstrating the relation between different alternator excitations and the common terminal voltage show that as the excitation is increased, the common voltage may be made to rise, but the current and the power conditions become bad. The variation of the voltage E for complete tests, embracing the whole range of alternator field variation, is shown in fig. 11 for different constant consumer loads. These curves show that the voltage at the common

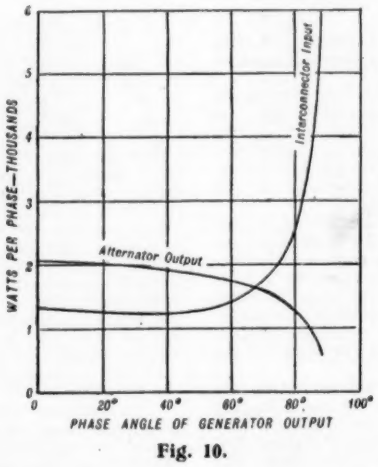


Fig. 10.

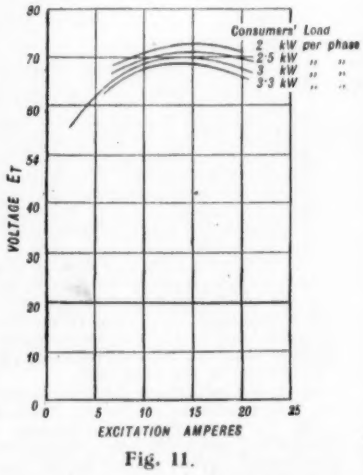


Fig. 11.

terminals rises to a maximum value as the excitation is increased, and then falls with greater values of excitation.

With a given consumers' load and alternator input, and with a given voltage at the remote end of the interconnector, for every value of alternator excitation there is generally a definite value of terminal voltage.

With the previously assumed power and voltage conditions, the voltage at the common terminals may have a maximum value for a certain alternator excitation.

The interconnector power supplied to a generator at a fixed terminal voltage may have a limiting value, just as it may have when supplying a motor.

In conclusion, I wish to state that the experimental work might have been much more fully developed if it had been possible to obtain a constant-voltage supply.

The present supply at Milner Park is from a tramway feeder, and the voltage oscillates over a wide range, so that readings have to be taken at long intervals when steady conditions seem to be reached.

The Physical Society's Exhibition.

Annual Display of Electrical Instruments and Scientific Apparatus.

WHAT is regarded as one of the chief scientific events of the season took place on January 10th, 11th, and 12th at the Imperial College of Science and Technology, South Kensington, being the eighteenth of the series of annual displays arranged by the Physical Society of London and the Optical Society to indicate the year's progress in the design and construction of electrical, physical, and optical apparatus and associated equipment.

In addition to the trade section of the show, in which 81 manufacturers participated this season (an increase of 7), a research and experimental section was included for the third year in succession; the group in this section consisted of 23 exhibitors (a decrease of 9).

Three discourses were delivered, one during each evening: Mr. A. Whitaker, of the Gramophone Co., Ltd., outlined "Progress in the Recording and Reproduction of Sound"; Mr. V. E. A. Pullin, B.A., O.B.E., F.Inst.P., described "Recent Applications of X-rays"; and Mr. J. W. T. Walsh, M.A., D.Sc., F.Inst.P., dealt with "Artificial Daylight."

We commence below brief descriptions of some of the newer instruments and apparatus of an electrical nature which were exhibited in the trade section of the show.

Messrs. Everett, Edgcumbe & Co., Ltd.

Instruments shown for the first time included a master meter (fig. 1) by means of which the frequency of a power station can be kept almost perfectly constant; in fact, expressed in terms of time, the frequency can readily be maintained to within ¼ minute per day (corresponding to an accuracy better than 1/50 of 1 per cent.). This is accomplished by means of an accurate clock, combined with a Warren synchronous motor, two hands, one driven by each motor, being mounted concentrically, so as to move over a single dial, or else so arranged that the clock and the motor act differentially upon a single hand. In either case the hands show the attendant at a glance whether the station frequency is correct, or above or below normal, thus enabling him to make the necessary correction to the turbine speed, with the certainty that he is maintaining a true average frequency and not merely correcting some temporary rise or fall which is likely to correct itself. Fig. 4 will give an idea of the compactness of the Warren motor and its simple construction: a rotating field is produced by the shading rings CC, and the annular steel rotor D is drawn round by hysteresis, the effect of eddy currents being quite negligible. As a result, the speed of the rotor is absolutely synchronous, irrespective of the load; the power consumption is only about 3 watts, and the gearing is such that the spindle E makes one revolution per minute, or one revolution per second, as may be desired. Amongst its numerous applications may be mentioned the driving of graphic meters (with the advantage that the charts are accurately synchronised, instead of being dependent upon the timekeeping of a number of separate clocks); the driving of time switches (thus saving the cost of winding and eliminating all errors in timing); the measurement of short intervals of time by means of a meter (fig. 2), which is particularly useful for checking time-lag relays, circuit breakers, &c.; the hand makes one revolution per second, and the dial is divided into 100 parts, so that 1/100 second can be read off.

Exceptional qualities have been obtained by the application of a nickel-iron alloy to moving-iron ammeters and voltmeters, eliminating the effects of hysteresis, so that such meters are now available for direct-current measurements; by careful design frequency and inductance errors have been so reduced that a truly interchangeable a.c. and d.c. instrument is now available.

A line of low-current bar-type current transformers with nickel-iron alloy cores gives quite remarkable results; for example, a 22-kV current transformer was exhibited, designed for a full-load of only 120 amperes, which had a ratio constant to within ¼ per cent. and a phase displacement of less than 1½ deg. at all primary currents down to 15 amperes. When power measurements are not involved, so that phase displacement between primary and secondary currents is unimportant, such transformers are available for full-loads as low as 20 amperes, an ammeter giving a clear reading from 0.15 to 15 amperes being shown, operated together with a super-sensitive over-current relay from a 20 to 1 current transformer of the bar type.

Fig. 5 shows a portable current transformer arranged for series-parallel connection which can be supplied for any desired primary current up to 200 amperes, normally suitable for use on circuits of any voltage up to 6,600 volts, and have Class A accuracy (B.S.S. 89), but, for special purposes, they can be given an accuracy such that down to 1/10 of full-load current the phase displacement does not exceed 5 minutes, and the ratio is correct to within 1/10 of 1 per cent.

Messrs. Everett, Edgcumbe & Co., realising the importance of compensating directional-current relays against the fall of voltage which is inevitable under severe fault conditions, more than 15 years ago introduced a reverse *current* relay which operated at a current which was, within wide limits, independent of the voltage, as distinct from the usual reverse *power* relay in which the current necessary to cause operation increased in proportion as the voltage fell. The importance of

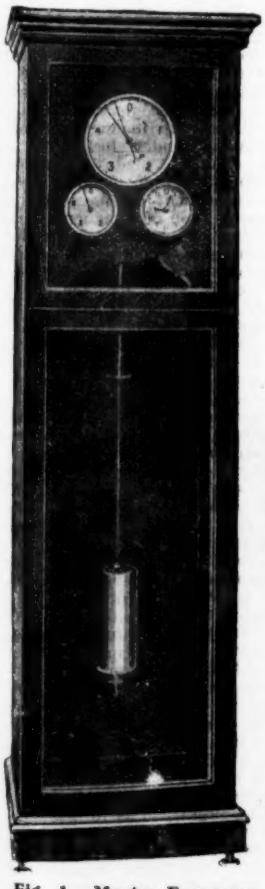


Fig. 1.—Master Frequency Meter.

Fig. 2.—Time-Interval Meter.

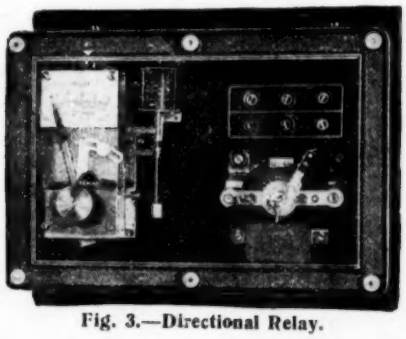


Fig. 3.—Directional Relay.

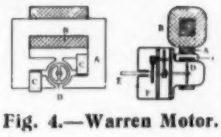


Fig. 4.—Warren Motor.

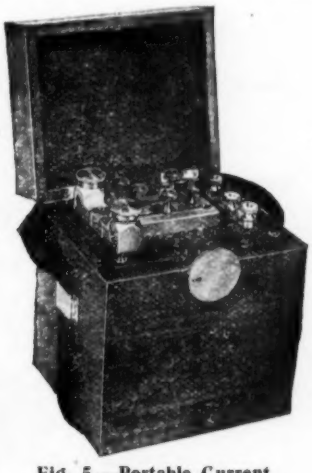


Fig. 5.—Portable Current Transformer.

this consideration is now fully recognised, and other compensated relays have been put upon the market. They are, however, mostly of the induction pattern, which is less efficient than the ironclad dynamometer principle adopted in their latest pattern of directional-current relay; fig. 3 shows one of these instruments provided with a definite time-lag device. They are also supplied for instantaneous operation, in the single-pole, two-pole, or three-pole form. The volt-ampere consumption of the current winding amounts to about 0.03 VA at the operating current, in the case of a relay set for 10 per cent. reversal, as compared with 3 VA allowed by B.S.S. 142 under similar conditions, which is of the utmost importance when a directional relay has to be operated from a bar-type current transformer. In the case of a relay set to operate at 10 per cent. of full load, if the voltage falls to 2 per cent. of normal, the current necessary to cause operation is only 30 per cent. above full load.

Induction ammeters and voltmeters have the advantage of a very long scale, but have been subject to large errors due to changes of temperature or of frequency. In the new design the usual shading ring is dispensed with, and the necessary phase displacement obtained by a second electromagnet, the current in the winding of which is made to lag about 45 deg. by shunting with a non-inductive resistance.

M-L Magneto Syndicate, Ltd.

This company's pneumatically-driven miner's electric lamp (fig. 6) is self-contained, and consists of a compressed-air turbine driving an electric generator and supplying current to a metal-filament lamp. Its chief field will be in explosive atmospheres, such as may occur in collieries, oil and petrol tanks, &c., and near explosives or inflammable substances, but it also has a wide field of application wherever compressed air is used for power purposes and electricity for lighting is not available, *e.g.*, tunnelling, and its adoption may obviate the necessity for running special electric cables to the working face. Particular attention has been paid to the elimination of any fire risk; the generator takes the form of an alternator with a revolving field magnet, so that there are no rubbing contacts or brushes of any sort carrying current, which might be liable to cause sparking; the whole of the generator casing and the protecting glass which covers the electric bulb is in communication with the exhaust side of the turbine, and the pressure is maintained at between 1 and 2 lb. per sq. in. by a spring-loaded exhaust valve. The outside atmosphere cannot,

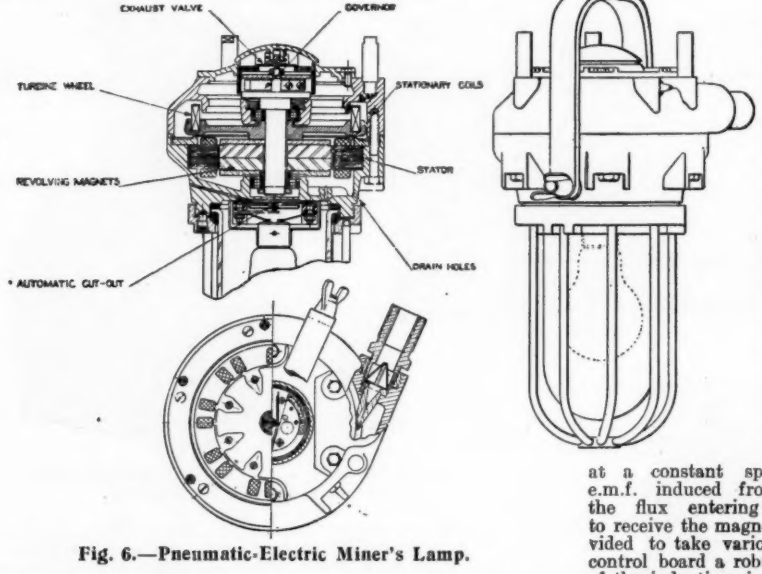


Fig. 6.—Pneumatic-Electric Miner's Lamp.

therefore, obtain access to the interior of the lamp when the latter is running. A further safeguard consists of a flexible walled chamber (similar to that of an aneroid barometer) which carries a contact that is forced by a spring against another contact on a fixed base; the contacts are across the terminals of the generator, which is, therefore, normally short circuited. The inside of the flexible chamber is maintained at atmospheric pressure; the outside of the chamber is subjected to the excess pressure in the protecting glass of the lamp. When the lamp is working and there is excess pressure in the protecting glass, the contacts are separated, and the lamp can light, but any failure of the excess pressure, due to removal or breakage of the protecting glass, immediately short circuits the generator. As a protection against the accumulation of gas in the protecting glass, or in the body of the lamp, a small hole communicates from this point to atmosphere, so that whenever the lamp is running a steady stream of scavenging air passes through the whole lamp. The lamp can be taken to pieces and the turbine removed without disturbing the safety cut-out or interfering with any wiring or connections. To prevent the lamp being overrun, should the air pressure rise unduly, or the turbine reach an excessive speed in the case of the bulb failing, a centrifugal governor is fitted to the turbine spindle, which consists of a pair of spring-controlled weights fitted with "Ferodo" friction surfaces which fly outwards and engage with the inner surface of a fixed brake drum. A special form of lamp is also available, fitted with a reflector giving a concentrated beam, and the generator is designed for a 60-watt 50-volt lamp, which, if gasfilled, will furnish between 90 and 100 c.p. The air consumption is about 10 cu. ft. per minute at all pressures above 40 lb. per sq. in.; the weight of the complete lamp is 16 lb.

Fig. 7.—Magnet-testing Outfit.

The outfit shown in fig. 7 is intended for the commercial testing of permanent magnets, either straight or slightly curved bars of cobalt steel in lengths of from 5 to 11 cm., or horseshoe magnets of tungsten or chromium steel in lengths from 15 to 35 cm.; these lengths cover practically the whole range of magnets in commercial use in magnetos and moving-coil instruments. The instrument gives direct readings in c.g.s. units, and no calculation is required to cover variations either in length or section of the sample tested, allowance therefore being made automatically when setting the apparatus. It is, therefore, suitable for use by unskilled labour, the total time required for observations of remanence and coercive force on a given magnet not exceeding 20 to 30 seconds, and accuracy within 5 per cent. can be obtained when used for commercial testing; a special feature is automatic compensation for the space between the magnetising coil and the magnet under test, and a single coil can be made to cover a very wide range of magnet sections. The instrument can be used for the (1) determination of remanence and coercive force; (2) plotting of the demagnetisation curve, *i.e.*, the relation of B to H; (3) determination of the maximum value of B × H, *i.e.*, the maximum energy which can be stored in a circuit energised by the magnet; (4) determination of the flux density and permeability at high densities and, by extrapolation, the true ferric saturation density of the material.

The apparatus comprises a unipolar dynamo, consisting of an iron disk revolving in an air gap between two pole pieces of high permeability iron, driven at a constant speed by a small electric motor; the e.m.f. induced from the disk serves as a measure of the flux entering the pole pieces, which are shaped to receive the magnet under test, special extensions being provided to take various forms of magnets and bars. On the control board a robust switch permits the continual breaking of the inductive circuit, without burning the contacts, magnetising being performed by drawing the switch down; on releasing the handle the switch is brought back into the demagnetising position by controlling springs, obviating the danger of the switch being accidentally left in the magnetising position, causing overheating of the magnetising coils. Coarse and fine adjustment rheostats control the current in the demagnetising circuit. A millivoltmeter connected to the generator serves to measure the flux in the magnet, and a section compensator working in conjunction with it is so arranged as to make the meter read directly the value of B in the steel; two dials giving coarse and fine adjustment automatically insert the appropriate resistance in the meter circuit, so as to make the reading give the flux density of the specimen. An ammeter in the demagnetising circuit is scaled to indicate the demagnetising force supplied to the steel; the length compensator works on the same principle as the section compensator, and a space flux compensator automatically injects into the circuit of the millivoltmeter e.m.f. equal to that produced in the generator by the space flux in the magnetising coil, automatically correcting for the space flux in the coil, and enabling readings to be obtained of the true ferric density in the iron itself.

(To be continued.)

Correspondence.

Correspondents should forward their communications **as early as possible.** *No letter can be published unless we have the writer's name and address in our possession.*

Radiological Apparatus.

May we, through the hospitality of your columns, be permitted to comment upon the article dealing with radiological apparatus, by an engineer-radiographer, which appears in your issue of January 6th?

As a result of your correspondent's visit to the recent London Radiological Exhibition, it would appear that he considers the X-ray industry in a very bad way indeed. This we absolutely decline to believe. We would assert that British manufacturers are fully alive to the requirements of the medical profession, and, furthermore, that the standards of efficiency and design were never so high as they are to-day.

There appear to be one or two statements in the article in question which are utterly fallacious. With these we shall not attempt to deal. One point in particular, however, we cannot allow to pass without notice. The statement that "the gas tube is still used to a large extent and that some stands appeared to show them as their chief line" is surely very wide of the mark. As a "radiographer," did he not see the "Metalix" tube? If he did, as an engineer, where were his constructional ideals?

For your information, Mr. Editor, we are pleased to send herewith an illustrated brochure showing apparatus by every British manufacturer, which was *definitely on view at the Exhibition.* Such advances, as is well known, are due entirely to the advent of the "Metalix" tube.

We should be pleased to send a copy to your correspondent if he is interested in the efficient generation of X-rays, and the construction of the hot-cathode tube which embodies its own protection. We feel sure he would be pleased to hear about it, especially if he is one of the 348 gentlemen who were the first to use X-rays in this country.

Philips Lamps, Ltd.,
W. F. AINSWORTH, *X-Ray Tube Department.*
London, *January 10th*, 1928.

We have read with great interest the article on "Radiological Apparatus" in the REVIEW of January 6th, and, whilst appreciating the various comments, we feel that your correspondent cannot be in the closest touch with modern thought and requirements in the design of X-ray apparatus.

The ordinary accepted standards of engineering practice cannot be applied to X-ray apparatus, and the designer has had, therefore, to create his own. In the eyes of a power engineer the design of some of the plant used in X-ray work may appear to violate all the well-accepted principles, but the fact remains that many hundreds of installations in daily use are giving perfect service, and that the designers' own created standards are correct is self-evident.

The necessity for standards applicable only to X-ray apparatus has been realised (as mentioned by your correspondent) by the action of the B.E.S.A. in appointing a sub-committee to draw up a specification for X-ray transformers. It is to be hoped that the activities of this body will be still further extended.

As to the apparent slackness in the use of standard engineering terms, it must be remembered that the terms used in describing the various parts of X-ray apparatus have more or less become fixed in the minds of the men using the apparatus, and, as is usually the case, it takes a very long time for any change to be wrought. Manufacturers are aware of this fact, and in many cases it has been found necessary to use both the old and the new nomenclature. A case in point is the voltmeter usually mounted on the control switchtable of an X-ray set and calibrated to read secondary kilovolts. These meters indicate peak kilovolts, but the manufacturer, realising the difficulty experienced by a radiologist educated to think in inches point-spark-gap, also provides on the scale plate the equivalent spark gap in inches against the kilovolt scale.

The inaccuracy of this particular meter is commented upon by your correspondent. Whilst we agree that the readings of this meter are inaccurate, the error is small and may be allowed for. It is a most useful meter to the radiologist, as it is so connected in circuit as to indicate the X-ray tube voltage before the tube current is actually switched on. For calibrating this meter a sphere-gap voltmeter must always be used.

The gospel of measurement of tube voltage by means of a sphere-gap voltmeter has now been preached for many years, and, in fact, a voltmeter of this type, designed by G. W. C. Kaye, was exhibited by us in July, 1920. As we said before, it is only by a gradual process that all X-ray workers can be educated to think in terms of kilovolts when they have been trained to think in inches spark gap. In connection with this question of voltage measurement, your correspondent mentions a direct-reading kilovoltmeter which may be permanently connected across the X-ray tube. We are extremely interested in such an instrument, and would appreciate further information.

It is quite true that the induction coil is almost a dead letter, but this is not so much due to the fact that alternating current is now being more widely generated and supplied (your correspondent does not seem to be aware that coil sets can be made to operate from alternating current with a special type of interrupter) as to the fact that the transformer and thermionic type of X-ray tube is so much easier to control, and results may always be repeated accurately. With the thermionic type of tube the voltage and current may be adjusted independently of each other, but with the gas-type tube to a great extent one depends on the other.

Rather contrary to your correspondent's ideas, gas tubes are being used less and less, especially by the younger school of radiologists. In many radiological teaching centres there is not a single gas tube installed, the result being, of course, that the radiologist there trained will not require this type of tube, and in due time we are quite confident that gas tubes will not be used at all for general radiological purposes. In connection with your correspondent's observation that the thermionic tube was not much in evidence at the Exhibition, as he has mentioned only the Coolidge tube, we assume he overlooked another make of thermionic tube which was on show. This tube was also exhibited by a number of the apparatus manufacturers as part of their equipment.

With regard to meters, we have made a practice of fitting British-made meters for many years past, and in so doing have sacrificed a certain percentage of our profits, inasmuch as the Continental article, whilst not being up to the standard of the British-made instrument, will do the work and is very much cheaper. Competition is extremely keen, every penny of cost has to be thought of, and, unfortunately, a number of manufacturers, in order to effect a saving, prefer to fit foreign-made instruments.

Whilst agreeing that a voltmeter should be connected across the filament of a thermionic valve tube, we are at a loss to understand why a similar practice should be advocated with regard to the X-ray tube filament. The voltage applied to a valve-tube filament is kept at a constant value, but that applied to the X-ray tube filament is varied to control the amount of high-pressure current which will pass through the X-ray tube. Whilst there is no real reason why a voltmeter should not be used, measurement of filament current has always been made, and is the present world-wide practice.

Some years ago we went to a great deal of trouble and expense to introduce an all-steel cabinet. It was not accepted: in addition to being very difficult to manufacture in the larger sizes and subject to drumming, due to the vibration of the rectifier apparatus, the general appearance was poor as compared with the wooden cabinet, and the medical man simply would not have it. In our experience we have not heard of a wooden cabinet catching fire, or of anyone receiving a shock through the wood-work. As a rule, clearances inside a wooden cabinet are the same as if it were made of metal. Present-day practice is, whenever possible, to install the equipment in a separate room from the radiographic room, in which case no cabinet is used at all. This is, perhaps, the ideal way, but cannot always be carried out.

The question of protecting the radiologist from electrical shock has always received our most careful consideration. Wherever possible the high-pressure leads are shielded by earthed metal: the overhead high-pressure conductors are rigidly made of metal tubing, so ensuring no risk of breakage, as was the case with the old wire system. In addition to this, many installations are fitted not only with a red lamp, which operates when the transformer is switched on, but also with a buzzer, the latter especially where a silent installation is being used, there being no rectifier motor noise to warn the operator that the set is working. Further, we have endeavoured to educate the X-ray operator to appreciate the dangers appertaining to the equipment. In this connection, on X-ray apparatus manufactured by us there is a warning notice, and, in addition, a warning card is supplied which may be hung in a prominent position in the X-ray room: a copy of this card we are pleased to send with this letter.

British X-ray apparatus to-day is scientifically designed and is second to none.

Watson & Sons (Electro-Medical), Ltd.,
H. GOUGH.
London, *January 12th*, 1928.

[The warning card is admirably worded and mounted, and emphatically drives home the necessity of observing the utmost caution when dealing with X-ray equipment.—EDS. ELEC. REV.]

The article in your issue of January 6th on "Radiological Apparatus," especially in connection with the recent exhibition at the Central Hall, Westminster, will be read with interest by all engaged in the science. It is, therefore, all the more important that such an article should be correct in every detail, and in certain respects your correspondent is not quite fair to the X-ray industry.

One would, in fact, suspect that he has gleaned his impressions from an inspection of one or two exhibits only, and, as in every industry, X-ray manufacturing in this country varies greatly in quality, there being firms which cater for the cheapest market and those which manufacture only a better, and therefore admittedly more expensive, grade of apparatus.

For instance, your correspondent states that X-ray manufacturers in general adopt measuring instruments of Continental

manufacture, whereas it is, I think, a fact that the better-class makers as a whole are using well-constructed British instruments, and it would be a pity if an impression were to get about that this was not the case.

On more technical matters again your correspondent would seem to suggest that the industry was in the hands of firms with little or no knowledge of electrical engineering, but speaking in general the "mistakes" that he points out have been adopted for absolutely good reasons. For instance, he suggests that the industry is wrong in not adopting sphere spark-gaps instead of point-and-plate spark-gaps in connection with radiological equipment.

It is an admitted fact that a sphere spark-gap is more accurate than a point-and-plate instrument, though the difference in accuracy is not so great as is somethimes supposed, but the radiologist is not in ordinary practice concerned to get very accurate measurements: in fact, the difference of a fraction of an inch in his alternative spark-gap is of little importance, but what he does want is a measurement that he can read quickly and easily and at some little distance away, frequently in semi-darkness, and when it is realised that a pressure of, say, 100 kilovolts will jump some 17 centimetres from point to plate and some 3.5 centimetres only between spheres, it is easy to see why the radiologist in actual practice prefers the former.

When it is further considered that by retaining a little ohmic resistance in the circuit a point-and-plate gap can be maintained with just such sign of effluve as will show that it is on the verge of sparking and yet without discharging, the advantage of such a gap will readily be seen.

To take another point, your correspondent criticises the term "motor-convertor," which he states is used by manufacturers to describe a machine of a common field system, but with two armature windings. Such a machine is extremely little used in the X-ray industry, the reason being that it is quite unsuited for heavy and sudden overloads, the machine in actual use as a rule being one with a single tapped winding; this is quite correctly described as a motor-convertor, and the term "motor-generator" would be obviously wrong.

Your correspondent's criticisms again regarding wooden *versus* metal cabinets would appear to be somewhat pointless. His main objection to a wooden cabinet seems to be based upon the fact that the end of a stretcher might be pushed through it. A stout cabinet of oak or mahogany would not be very easily damaged in such a way, and also doors of hard wood are actually admitted under the County Council regulations as being reasonably fire-proof from an emergency point of view, though incidentally I have never heard of an X-ray apparatus catching fire.

X-ray cabinets are usually made of wood: (1) because a good many radiologists quite rightly prefer a handsome piece of furniture in their consulting rooms; (2) X-ray manufacturers know by experience the drawback of introducing any more capacity into the total equipment that can possibly be avoided.

The corona-less overhead system rightly insisted on to-day from the point of view of the health of the operator, is extremely detrimental as regards the bugbear of high-frequency oscillations, and I venture to assert that if and when metal cabinets become general, it will be on the score of cheapness or possibly considerations of hygiene rather than for the reasons suggested by your correspondent.

I should also like to criticise your correspondent's strictures regarding voltmeters *versus* ammeters in the filament circuit. These observations are to a great extent sound, although unfortunately neither instrument is correct, and it is a fine debatable point which is really the better.

If the reading is taken by an ammeter and this reading is kept constant, the heat of the filament will tend to increase as wastage occurs and therefore the life of the valve may be somewhat shortened; but on the other hand, if a voltmeter reading is taken and likewise kept constant, as the filament deteriorates the current will decrease; in consequence the life of the valve may be prolonged, but on the other hand there is the danger that the valve or valves may themselves become sources of X-ray radiation. This is especially the case as the ionic activity of the cathode depends not only on heat but also upon superficial area, and therefore as wastage occurs the filament has to be made somewhat hotter in proportion. This effect is not generally known, but it has become elucidated after very careful investigation and has to be very seriously taken into account in maintaining a constant current.

In practice either ammeter or voltmeter is reasonably satisfactory, and in the present state of scientific knowledge I do not think that anybody can fairly criticise a manufacturer for adopting either instrument.

In general, I do not think that it can be fairly said that X ray manufacturers or practitioners are either conservative or prejudiced, and when X-ray construction differs from what your correspondent would consider correct engineering practice, he may take it for granted there is a very good reason for it.

London, *January 13th*, 1928. **W. S. R.**

Voltage Variation on Rural Supply Mains.

The letter from "Stability" in your issue of the 18th ult. attacks this problem from a very practical point of view, but it has exceeded the figure suggested by me, *viz.*, 8 per cent., by 2 per cent., which is thus 25 per cent. more than I asked for! My case was that when 4 per cent. was fixed by the Board of Trade, the variation in light resulting from the then existing carbon lamp was as much on 4 per cent., as would exist to-day on an 8 per cent. variation. As it was only light which the Board of Trade had in mind, it is obvious that if metal lamps had then existed they would probably have fixed 8 per cent. even for cities, and certainly for country supplies if they had even dreamed of the possibility of supply outside towns.

In devising the means to get the supply into the rural districts one has to remember that there are two transformer drops to consider, as well as high- and low-pressure c.r. drops if on a parallel system. It is obvious that the whole of the present $2 \times 4 = 8$ per cent. is absorbed in the transformers and h.p. drop and nothing is left for power station variations and low-pressure mains, for which another 8 per cent. is moderate. The result is then that anyone running a line into rural areas on any but the series system, which has its own defects, *must* to-day be a law breaker. Dare anyone suggest the series system to-day?* It solves the c.r. drop question, but would be distinctly "non-standard." Unless, therefore, the conditions are made possible, there will be either compulsory breach of the regulations or an absence of electric light, heat, cooking, and power, as there is no alternative but a private plant, which few can afford.

With regard to power, a good d.c. motor varies in speed 1 per cent. for 1 per cent. variation, so we would have a ± 4 per cent. variation—better regulation than any small petrol or oil engine would give. The solution of the a.c. motor overload problem is to order for the lower limit—a moderate rise in voltage does no harm. Besides, the voltage will never be at the higher limit when the motor is operating at the end of a long line.

The neutral drop complaint of your correspondent would be cured by adopting my proposal, which has met with general approval, to earth all neutral conductors each quarter of a mile. The existing neutral drop, on 4-wire systems especially, is a very serious matter even in towns. It makes that system impossible in any country area, so much so that I have cut it out for country work, substituting single-phase high-pressure with local transformers supplying each large consumer or cluster of consumers.

W. Fennell.

Northwich, *January 14th*, 1928.

[* See ELEC. REV., January 13th, 1928, p. 48.]

A Rental Prepayment Meter.

It is nearly 12 months since this subject was in the limelight, and the last I heard of it was that the Meter Engineers' Association would deal with the matter.

I think those engineers who are interested in the subject would like to know that a meter is now available, and on the market, in the shape of the A.E.G. "rental prepayment meter," which collects the fixed charge, and also the charge for energy. Unfortunately, this meter is only made for a.c. at present, but I live in hope that one will be devised for d.c. at an early date, and this has been partly promised to me.

H. W. Watts,
Resident Electrical Engineer.

Electricity Department, Epsom,
January 10th, 1928.

Progress Organisation.

I was very much interested in the article in last week's REVIEW on this subject. You were good enough to publish one by myself in your issue of August 26th, 1921. The great trouble with all progress work is the human factor. The sales organisation is frequently confronted with this problem: a very good friend of the company wants something, immediately, if not sooner; the following is the usual procedure:—On the telephone the Progress Department is asked for a very quick delivery—"very urgent," "super priority," &c. "Oh, that is no good! Mr. X is a great friend of the managing director; you must wangle it in somehow."

The Progress Department replies: "Go and tell the managing director who seems to be like Mr. Twemlow that there are three promises of thrice-amended dates for his other three best friends. Get a ruling from him as to which is the best friend, and also stand by for explanations to the other best friends."

It is, of course, understood that the works are always "hopeless"—they can never respond to an emergency, and so on. The Sales Department generally knows nothing about works production problems—and, of course, every order is most important. I think that the Progress Department should have at its head an engineer who has held with success a post of superior responsibility in administrative work in the factory and has had similar responsibility on the outside staff, both as construction engineer and also as district sales manager. In other words, the progress manager should be a man of all-round experience, able to understand the Sales Department's desire to keep and make friends, and also the works' desire to make the goods at a profit. He should also be endowed with very considerable tact, and his position in the works should be such that he could go to the general works manager and say on occasion: "I think it would be as well for me to go and see this man and explain the situation to him personally." However good the progress organisation may be, the head of it should be a man of wide experience of

men and affairs. Some years ago I organised a progress department and managed to keep the complaint basket in a subordinate position on the managing director's table, but that was only because I was given authority. The progress manager has to deal with the individual who thinks that when he gives an order for, say, £30, traffic should be stopped while his letter is being delivered. Then he has another type to meet—the broad-gauge man who places an order for £3,000 and says: "Well, do the best you can, and keep me posted about your progress." Human nature being frail, it is not to be wondered at that the last-named type gets served first so often. Lastly, the sales organisation has so often a tendency to hear the birds singing and to get blood pressure when a fair-sized order comes in; then on the telephone the progress manager hears: "My dear fellow, you must push on with this order." If you dwarf in importance the Progress Department to a mere accident of routine procedure, that is how you will get deliveries—they will be the accident of routine procedure. The Progress Department should be a responsible office, and if anyone goes behind that office he should be taken out and hit once on the head with a 2-in. spanner and buried behind the foundry.

London, *January 10th*, 1928. **Edgar Loam, M.I.E.E.**

Domestic Heating and the Load Factor.

I very much regret that in my letter to you of the 2nd inst., which you were good enough to publish in the current issue of the ELECTRICAL REVIEW, a very unfortunate error crept in with regard to my second suggestion, substituting ½d. for ¼d. As most of your readers will obviously realise, this should have read: £4 per kW of maximum . . . and ¼d. per unit.

I note that you have made reference in your leaderette to my remarks, but I fear that this may be a little misleading. My whole point with regard to tariffs is that the authority receiving a bulk supply has to pay on the maximum demand of the load, which is a completely different condition to that obtaining in local generation, and it is precisely this point that I am desirous of emphasising in the construction of bulk supply tariffs.

A. W. Blake,
Electricity Department, Willesden, *Electrical Engineer.*
January 13th, 1928.

The Legal Position of a Receiver and Manager.

The letter in your issue of the 13th inst. under the above heading is rather misleading. It states that the legal position is that the receiver appointed by the debenture-holders is not personally liable for payment for goods ordered by him—this is correct—but it is also stated that the debenture-holders who appoint him incur no responsibility; this is only true where the debenture instrument specially provides for the company to be held liable, otherwise the debenture-holders are themselves liable for all goods ordered by the receiver and manager they appoint.

"If an appointment is made under powers in the Debenture instrument it is often assumed on the authority of Owen *v.* Cronk (1895, 1, Q.B. 265) and Gosling *v.* Gaskell (1897, A.C. 575) that a Receiver and Manager carrying on a business is necessarily the agent of the Company, but this is not so; in the cases named the Debenture instrument contained a clause making this special provision. But if no such clause appears, then the Receiver, so far as he carries on the business, is the agent of those who appoint him." (Spicer & Pegler . . . "Rights and Duties of Receivers.").

We think that your correspondent's suggestion is very sound, that in all cases where the debenture-holders have no responsibility attached to them it should be compulsory for the receiver and manager to make this quite clear on all orders issued by him.

Higgs Motors,
W. B. THOMAS,
Birmingham, *January 14th*, 1928. *Accountant.*

Re-building Shafts by Electric Welding.

We have read with interest the letter on this subject from your correspondent, and would state for his information that there is not the slightest difficulty in carrying out this operation provided that the right electrodes are used.

We would be only too pleased to give him any assistance in this matter, and would carry out any work for him of this nature, either at his works or our own

The reason for his apparent failure to obtain good results is obvious.

Weldrics (1922), Ltd.,
A. D. ANDERSON, *Director.*
Beeston, *January 13th*, 1928.

The remedy sought by "Inquirer" with reference to the rebuilding of armature shafts without disturbing the windings is found in the "Fescol" process of electrodeposition; this is a cold process. See "Chromium Plating," page 53, ELECTRICAL REVIEW, January 13th last.

January 14*th*, 1928. **A. W. A.**

The Golden Age for Inventors.

"A.P." in his remarks on the above subject refers to a snag. As an inventor I am afraid "A.P." must blame himself for the snag, although I quite sympathise with him.

Before putting the invention before the public he should have approached manufacturers with a view to being able to deliver the goods. I am ready to admit this has its difficulties but patience and perseverance are the necessary qualities of an inventor.

A. W. Saulter.
London, S.E., *January 13th*, 1928.

[Several letters are unavoidably held over to our next issue.—EDS. ELEC. REV.]

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

1926.

13,278. "Sound-reproducing apparatus." C. M. R. Balbi. April 5th, 1927. (282,127.)

16,744. "Apparatus for transmitting and recording sound." J. Henley and H. V. Flinn. July 3rd, 1926. (282,469.)

20,793. "Telegraph." W. S. Smith, N. W. McLachlan, and W. G. R. Jacob. August 23rd, 1926. (282,476.)

20,794. "Cable telegraphy and the like." W. S. Smith, and N. W. McLachlan. August 23rd, 1926. (282,477.)

22,778. "Alternating-current motor starters or controllers. H. V. James and A. H. Stevens. September 15th, 1926. (282,483.)

22,954. "Railway signalling systems." A. E. Tattersall, F. Downes, and Westinghouse Brake & Saxby Signal Co., Ltd. September 17th, 1926. (282,484.)

23,178. "Electrical pole-changing systems." H. Weinert. September 20th, 1926. (Convention date not granted.) (258,618.)

23,439. "Electric heaters." B. L. Klemens. September 22nd, 1926. (282,464.)

23,519. "Telegraph system." Western Union Telegraph Co. August 6th, 1926. (275,538.)

23,538. "Illuminating and signalling devices for motor road vehicles." Anti-Glare, Ltd., and L. Harris n. September 23rd, 1926. (282,501.)

23,553. "Jack for electrical connections." W. J. Charlesworth. September 24th, 1926. (282,491.)

23,700. "Loaded electric conductors." W. S. Smith, H. J. Garnett, and J. A. Holden. September 25th, 1926. (282,504.)

23,801. "Electric lighting and similar installations for railway and other vehicles." J. Stone & Co., Ltd. (C. J. H. Bolton). September 27th, 1926. (282,507.)

23,894. "Coin-slot apparatus chiefly for controlling electric supply." R. Hornby and E. H. Wratten. September 28th, 1926. (Cognate application, 23,736/26.) (282,509.)

24,668. "Distributors for magneto-electric machines." British Thomson-Houston Co., Ltd., E. G. Parrott, and J. H. Pollard. October 5th, 1926. (282,512.)

25,129. "Electric switches." Electrical Appliances (Blackpool), Ltd., and R. T. Waite. October 9th, 1926. (282,513.)

27,210. "Method of and apparatus for operating electric arc-welding systems." J. C. Macfarlane and W. A. Macfarlane. October 30th, 1926. (282,527.)

28,060. "Electric bulbs for use in vehicle headlamps." G. De L. Wooldridge. November 8th, 1926. (282,535.)

28,179. "Electric remote control systems." W. E. Beatty (Western Electric Co., Inc.). November 9th, 1926. (282,536.)

28,297. "Manufacture of cathodes for thermionic valves." General Electric Co., Ltd. (Dr. A. Just). November 10th, 1926. (282,539.)

32,302. "Electric lampholders or sockets." J. H. Tucker & Co., Ltd., J. B. Tucker, and T. R. Martin. December 21st, 1926. (282,551.)

1927.

51. "Electric sound-emitting devices or loud-speakers." International General Electric Co., Inc. January 22nd, 1926. (264,811.)

319. Electrical massage instrument which can be used on any part of the body without assistance. A. W. Scott. January 5th, 1927. (282,555.)

2,301. "Discharge tubes having an enclosed arc discharge." Naamlooze Vennootschap Philips' Gloeilampenfabrieken. January 29th, 1926. (265,204.)

5,838. "Automatic control switches for electric circuits." Whipp & Bourne, Ltd., and F. Whipp. March 2nd, 1927. (282,575.)

7,328. "Electric light signals." Siemens & Halske Akt.-Ges. March 30th, 1926. (268,752.)

7,834. "Electric dry batteries." J. F. Smith (Naamlooze Vennootschap Elementenfabriek Utrecht Battery Co., E.F.U.). March 22nd, 1927. (282,578.)

9,459. "Electric condensers." F. Horney. January 25th, 1927. (282,580.)

10,035. "Apparatus for rectifying electric currents." E. F. Andrews. April 12th, 1926. (269,544.)

10,213. "Unpolarised electromagnetic relays." O. Collett & Co., Aktieselskapet. February 4th, 1927. (282,582.)

15,106. "Upright insulators for high-tension electric currents." F. Berg. June 7th, 1927. (282,592.)

17,060. "Light signals." General Railway Signal Co. August 25th, 1926. (276,629.)

18,594. "Electrical amplifying apparatus." Westinghouse Electric & Manufacturing Co. July 17th, 1926. (274,472.)

18,849. "Frequency-regulating devices suitable for use in wireless signalling." Soc. Francaise Radio Electrique. July 23rd, 1926. (Addition to 239,856.) (274,856.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from January 11th:—

Harbros. No. 484,648. Class 8. Electric flexibles covered with artificial silk or the like materials.—Hart Bros. Electrical Manufacturing Co., Ltd., 4, Queensway, Ponders End, Middlesex.

Vilite. No. 485,535. Class 11. Ultra-violet ray apparatus for surgical or curative purposes, and Vilitometer, No. 485,536, Class 8, electric time switches.—Sun-Vi-Lite Co., Ltd., Rolls Chambers, 89, Chancery Lane, W.C.2.

Unitalk. No. 486,148. Class 8. Telephonic apparatus and instruments and instruments and apparatus for radio communication.—W. Charles Davey, trading as W. C. Davey & Co., 27-29, Mortimer Market, Tottenham Court Road, W.C.1.

Thermor. No. 481,833. Class 18. Electric heating apparatus.—Adrien Maure, Orleans, France. (British representatives, Boult, Wade & Tennant, 112, Hatton Garden, E.C.1.)

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

AYLESBURY.—Electric light installation, Children's Home, Kimble, for the B.G.; W. J. Taylor, clerk.

AYLESHAM (DOVER).—Church; Ian B. M. Hamilton, architect, Lincoln's Inn, London.

BARNSLEY.—Extensions to Barnsley and District Holgate Grammar School, Shaw Lane; Dyson, Cawthorne and Coles, architects, 10, Regent Street. Re-erection (after fire), of the corn exchange for the T.C.; borough surveyor.

BARRHEAD (N.B.).—Housing scheme (200), Arthurlie estate; burgh surveyor.

BATH.—Roman Catholic church, Oldfield Park; J. Long and Sons, builders.

BATLEY.—44 houses, housing estate off Bradford Road W.; H. L. Hall, surveyor, Brunswick Street.

BEBINGTON.—Additional 200 houses for Birkenhead Corporation; Birkenhead borough surveyor.

BEWDLEY.—Housing scheme (30); Gething and Ralley, architects, Kidderminster.

BIRKENHEAD.—Shops and houses, Gautby Road and Hoylake Road; Birkenhead Co-operative Society, Ltd.

BIRMINGHAM.—Extension, Salvage Depôt, River Cole; city engineer.

BIRSTALL.—Central Stores (£11,000), for the Co-operative Society; T. Kelsall, secretary.

BOLTON.—Dance hall, café, shops, billiard saloon, &c., for the Palais de Danse (Bolton), Ltd.; Albert Winstanley, architect, Manchester.

BRADFORD.—Additional accommodation at College of Art and Crafts; city architect, Town Hall. Eight shops and 23 houses, Lower Grange estate; city architect. Clinic and welfare centre, Lower Grange housing estate; city architect.

BRAINTREE.—Housing scheme (28), for the U.D.C.; D. G. Armstrong, architect, Great Square.

BRENTWOOD.—Nurses' home (£21,250), mental hospital, for the Committee of Visitors; clerk.

CASTLEFORD.—Re-erection (after fire), of the public market hall, for the U.D.C.; surveyor.

CHESHIRE.—Schools, Ellesmere Port (£25,041), Bebington (£97,635), and extensions, Hyde secondary school (£14,373), for the E.C.; director of education, Chester.

COLCHESTER.—Housing scheme (93); borough surveyor.

COVENTRY.—Housing programme for ten years (3,000), for the T.C.; borough surveyor.

DAGENHAM (ESSEX).—Houses (44), Foxlands Road, for H. C. Seymour and F. C. Chillingworth. Block of 11 shops, Chadwell Heath, for Ashton & Wade. Four schools (£32,028), for Essex E.C.; J. Stuart, county architect, Chelmsford.

DUNDEE.—Additions for Scottish Co-operative Wholesale Society in Seagate; the manager.

DUNMOW.—Extensions to water works pumping station, with machinery, for the R.D.C.; Sands & Walker, engineers, Milton Street, Nottingham.

EDINBURGH.—Cinema, Leith Street (£70,000), for F. A. Lumley. Cinema (£45,000), Torphichen Street, for the Rutland Square Picture House, Ltd.

EYNESBURY (ST. NEOTS, HUNTS.).—Church for the Primitive Methodist trustees; H. Kellett Armitage, architect, 130, Haverstock Hill, Belsize Park, London, N.W.

FELTHAM.—Housing scheme (44), in Staines Road; Mr. Hoskins, Cranbrook Road, Hounslow.

GLOUCESTER.—Works extensions, Barton Street, for Williams & James.

HALESOWEN.—Roman Catholic church, Surtee Street; rector. Additional 50 houses, for the U.D.C.; surveyor.

HALIFAX.—Erection pathological block, Royal Infirmary, Halifax; Walsh & Maddock, chartered architects and surveyors, 10, Harrison Road.

HAM.—Factory for Cellon, Ltd., aeroplane dope manufacturers, Richmond-on-Thames.

HARTSHORNE AND SEALS.—Houses (50), for the U.D.C.; Morley & Sons, builders, Derby.

HORBURY (YORKSHIRE).—Cinema, for Horbury Co-operative Society, Ltd.; W. Sugars, architect.

HULL.—Theatre, Anlaby Road; Blackmore, Sykes & Co., Ruskin Chambers, Scale Lane. Garage; city architect.

IRISH FREE STATE (RATHDRUM, Co. WICKLOW).—Convent at the County Home for the County Board of Health; Jones & Kelly, architects, 17, South Frederick Street, Dublin.

LEAMINGTON.—Museum extensions (£7,000); A. C. Bunch, architect.

LEEDS.—Gas depôt, New York Road (£50,000); J. H. Wood and Co., Ltd.

LEIGH (LANCS.).—Housing scheme (40); C. R. Lynam, engineer and surveyor to R.D.C., 5, Market Place. New Sacred Heart Roman Catholic Church; rector.

LINCOLN.—'Bus garage (23,329), and maternity hospital (£18,250), for the City Council; city engineer.

LONDON (EAST HAM, E.).—Bath improvements (£18,000); borough engineer. Bank, Green Street; Whinney, Son, and Austin Hall.

(HACKNEY, E.).—Tenements for 100 families, Southwold Road; borough engineer.

(HOLLOWAY, N.).—Bedrooms, Royal Northern Hospital; Metropolitan Asylums Board.

(KENTISH TOWN, N.W.).—New buildings, St. Margaret's Hospital (£4,265); Metropolitan Asylums Board.

(PECKHAM, S.E.).—4 shops, Queen's Road; W. F. Blake.

(WESTMINSTER, S.W.).—Buildings, site in Tufton Street and Marsham Street; Browett, Taylor, Robertson & Morgan. Building over Metropolitan Railway, St. James' Park Station; G. Vernon. Alterations and additions, 170, Regent Street; Bywaters & Sons, Ltd. Flats, Exhibition Road; T. P. Bennett & Son.

LUTON (BEDS.).—Mineral water factory, Oxford Road, for J. Burgess. Works extensions, Davis Gas Stove Co., Ltd. 'Bus garage, National Omnibus and Transport Co., Ltd.

MANCHESTER.—Electric lighting, Abbey Hey school; Education Committee.

MANSFIELD.—Block of shops and offices (£7,500), for the T.C.; borough surveyor.

MONTROSE.—Reconstruction of Messrs. Robert Millar and Sons, Ltd.'s Victoria Planing Mills (destroyed by fire); W. M. Patrick & Co., architects, 19, High Street.

NORTHAMPTON.—Extensions, county offices (£22,000); Brown & Fisher, architects, Wellingborough.

OLDHAM.—Greyhound race track, Honeywell Lane; J. F. Jones.

OTLEY.—Cinema, Beech Hill; Otley Entertainments Co.

OXFORD.—Alterations, Pembroke College; the Bursar.

PETERBOROUGH.—Bank, for the National Provincial Bank, Ltd.; John Thompson & Co., Ltd., builders.

PLYMOUTH.—Assembly hall, 28-32, Mutley Plain; J. R. Randall. 32 flats, North Prospect, and 236 houses, Prospect Estate; borough engineer. Hospital re-organisation and provision new accommodation; Corporation architect and medical officer of health. Extension, smallpox hospital (£6,000); borough engineer.

PUDSEY.—Swimming and other baths (£12,000), to be used in winter as concert, dancing hall, &c.; B. H. Noble, borough surveyor, Town Hall.

READING.—Factory extensions, Gosbrook Road, for Samuel Elliott & Sons, Ltd.

RUSHDEN (NORTHANTS.).—Housing scheme (52), for the U.D.C.; surveyor.

ROMFORD.—Houses (34), Weald Estate, for Logan Estates, Ltd. Houses (52), Hill View and Oaks Avenues, for T. A. Clark. Houses (38), Aveley Road, for W. H. Kitteridge.

ROSS (HEREFORDSHIRE).—Housing scheme (50), for the U.D.C.; Mr. Tickle, architect.

RUGBY.—Extensions, Hospital of St. Cross; Young & Hall, architects, London.

SKEGNESS.—Re-erection, after fire, of Town Hall, for the U.D.C.; surveyor.

SMETHWICK.—School, Old Chapel Estate, for the Borough E.C.; Frank Chapman, clerk.

SUTTON COLDFIELD.—Roman Catholic Church near St. Nicholas Church; Rev. Father Faulconer Morgan.

SWINTON (LANCS.).—Post office and telephone exchange, for H.M. Office of Works, King Charles Street, London, S.W.

TORQUAY.—Sun lounge, medical baths, with electric heating, for the T.C.; H. C. Jackman, builder.

URMSTON (NR. MANCHESTER).—Housing scheme (48); J. Heath, surveyor to U.D.C., Council Offices.

WALMER.—Houses (35), for Denne, Ltd.

WARRINGTON.—Pattern store, Stafford Road; Ferrous Light Castings Co., Ltd.

WIGAN.—Electric lighting, Poor Law Institution; Board of Guardians.

WOKING.—Additions, garage, Victoria Road; Aldershot Traction Co., Ltd.